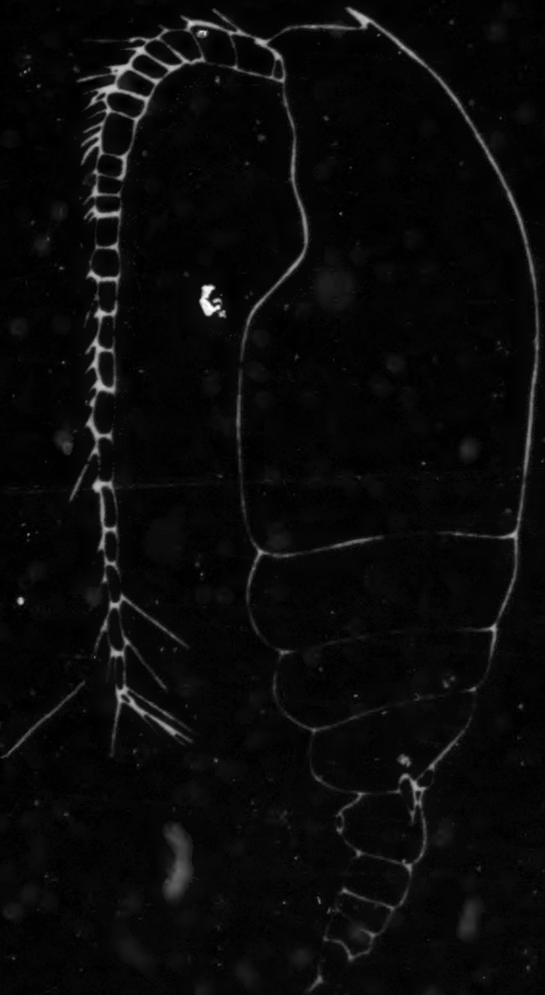
British Columbia Pelagic Marine Copepoda:

An Identification Manual and Annotated Bibliography



84- 2839 /

Canadian Special Publication of Fisheries and Aquatic Sciences 62

British Columbia Pelagic Marine Copepoda:
An Identification Manual and Annotated Bibliography[1]

G. A. Gardner[2] and I. Szabo

E.V.S. Consultants Ltd.
Marine Technology Centre
9865 West Saanich Road
Sidney, British Columbia
V8L 3S1

Department of Fisheries and Oceans
Ottawa 1982

---

[1] Prepared under DSS Contract 05SB.FP833-0-1758 for the Department of Fisheries and Oceans. Scientific authority Dr. R. O. Brinkhurst, Ocean Ecology Laboratory, Institute of Ocean Sciences, 9860 West Saanich Road, Sidney, B.C.

[2] Present address: Department of Biology, Memorial University of Newfoundland, St. John's, Newfoundland A1B 3X9.

Published by | Publié par

Government of Canada
Fisheries and Oceans

Gouvernement du Canada
Pêches et Océans

Scientific Information
and Publications Branch

Direction de l'information
et des publications scientifiques

Ottawa K1A 0E6

© Minister of Supply and Services Canada 1982

Available from authorized bookstore agents and other bookstores
or you may send your prepaid order to the
Canadian Government Publishing Centre
Supply and Services Canada, Hull, Quebec K1A 0S9

Make cheques or money orders payable in Canadian funds
to the Receiver General for Canada

A deposit copy of this publication is also available
for reference in public libraries across Canada

Cat. No. Fs 41-31/62E
Canada: $17.95
Other countries: $21.55
ISBN 0-660-11250-7
ISSN 0706-6481

Price subject to change without notice

Printed in Canada

Correct citation for this publication:

Gardner, G. A., and I. Szabo. 1982. British Columbia pelagic marine copepoda: an identification manual and annotated bibliography. Can. Spec. Publ. Fish. Aquat. Sci. 62: 536 p.

TABLE OF CONTENTS

Page

ACKNOWLEDGEMENTS v
ABSTRACT/RÉSUMÉ vi

PART I - An Identification Manual

1.0 INTRODUCTION 1

Background 1
Geographic Limits 2
Methodology 2
Copepod Morphology and Systematics 6
Copepod Life Histories 13
Format and Use 16
Summary 19
Glossary 20
Species List 24

2.0 KG1: KEY TO THE ORDERS OF COPEPODS 29

3.0 KG2: KEY TO THE HARPACTICOIDA 30

4.0 KG3: KEY TO THE MONSTRILLOIDA 31

5.0 KG4: ENTRY KEY TO THE CYCLOPOIDA 32

5.1 Keys to the Cyclopoida 33

6.0 KG5: ENTRY KEY TO THE CALANOIDA 37

6.1 Characters used in the Breakdown of KG5 39
6.2 Keys to Subgroups of the Calanoida 40
6.3 Keys to Species of the Calanoida 44

7.0 SPECIES DESCRIPTIONS 75

7.1 Harpacticoida 75
7.2 Monstrilloida 81
7.3 Cyclopoida 93
7.4 Calanoida 135

8.0 INDEX TO IDENTIFICATION MANUAL 426

Page

PART II - Annotated Bibliography and Ancillary References

9.0 INTRODUCTION 433

10.0 ANNOTATED BIBLIOGRAPHY 434

10.1 Index to Annotated Bibliography 507

11.0 ANCILLARY REFERENCES 516

ACKNOWLEDGEMENTS

We wish to thank Charles C. Davis, David L. Mackas and Ralph O. Brinkhurst for their assistance and cooperation during the course of this study. We would also like to thank Patricia M. Kimber, Margaret Frank, Sus Tabata, Brian M. Watt, and Ken R. Holman for their advice and help with the illustrations.

Preparation of this manual was made possible by Government of Canada funding (DSS Contract 05SB.FP833-0-[illegible]758) through the Department of Fisheries and Oceans, Institute of Ocean Sciences, Sidney, B.C. to E.V.S. Consultants Ltd. The authors wish to express their appreciation to the staff of E.V.S. Consultants Ltd. and particularly to Deedee Kathman and Peter M. Chapman who undertook supervision of this project.

We would also like to thank Marla K. Mees for her patience and care in preparing the draft and final manuscript.

ABSTRACT

Gardner, G. A., and I. Szabo. 1982. British Columbia pelagic marine copepoda: an identification manual and annotated bibliography. Can. Spec. Publ. Fish. Aquat. Sci. 62: 536 p.

This publication contains a complete species list of 121 pelagic marine Calanoida, Cyclopoida, Monstrilloida and Harpacticoida reported from the net zooplankton (i.e. species retained by a mesh size of ca. 335 µm) of British Columbia waters.

Part I is an identification manual with a tabular key, genera and species descriptions and species illustrations. Species descriptions summarize synonymies, morphology, reported global and local distribution, known life history information and major references. Information on ecology and present taxonomic status is included where appropriate.

Part II is a bibliography presented in two sections. Section I is an annotated bibliography to the literature dealing with the taxonomy and juvenile development of the copepods listed in the identification manual. The annotated section has a separate index. Section II presents taxonomic references that are not readily accessible and ancillary references on distributional and ecological topics.

RÉSUMÉ

Gardner, G. A., and I. Szabo. 1982. British Columbia pelagic marine copepoda: an identification manual and annotated bibliography. Can. Spec. Publ. Fish. Aquat. Sci. 62: 536 p.

Cette publication contient une liste complète des 121 Calanoida, Cyclopoida, Monstrilloida et Harpacticoida marins pélagiques trouvés dans le zooplancton tamisé (c.-à-d. les espèces retenues par un vide de maille d'environ 335 µm) des eaux côtières de la Colombie-Britannique.

La 1re partie est un manuel d'identification comprenant une clé, description des genres et des espèces et illustrations des espèces. La description des espèces inclut synonymes, morphologie, distribution globale et locale, cycle biologique connu et principales références. Au besoin, on donne une information sur l'écologie et la position taxonomique actuelle.

La 2e partie contient une bibliographie présentée en deux sections. La première est une bibliographie annotée des travaux publiés sur la taxonomic et le développement des jeunes copépodes mentionnés dans le manuel d'identification. Cette section a son propre index. La seconde contient des références taxonomiques qui ne sont pas facilement accessibles ainsi que des références supplémentaires sur la distribution et l'écologie.

PART I

AN IDENTIFICATION MANUAL

1.0 INTRODUCTION

This manual contains the first comprehensive key to marine planktonic copepods found in British Columbia coastal waters. The manual is designed for the technically oriented user with little expertise in copepod systematics, but also incorporates extensive reference information valuable to researchers already familiar with local species.

Restricting the key to local coastal waters reduces the number of species that must be included. Although identification of some of these species still requires the examination of dissected body parts, identification to genus and often to species can in many cases be based solely on gross morphological characteristics. With practice, almost all copepod species commonly encountered in the zooplankton of British Columbia coastal waters can be differentiated without dissection.

Background

Zooplankton research on this coast has been limited by the lack of any single reference for the accurate identification of marine copepods. The commonly used keys have been Brodsky (1950) and Davis (1949). Brodsky's (1950) extensive work addresses the whole of the North Pacific Ocean, and although Davis (1949) focuses on the northeastern Pacific, both these keys have become somewhat dated due to subsequent changes in generic and specific definitions, redescriptions of many species, and new records of species distribution.

Fulton (1972) produced a working key to local copepods which was intentionally oversimplified and restricted to copepods found in the Strait of Georgia. However, it has been extremely valuable to those working with British Columbia marine zooplankton.

The present manual and its associated bibliography combine all taxonomic literature pertinent to British Columbia marine copepods to provide a comprehensive key to the known free-swimming species in British Columbia waters. The occurrence of a number of reported species in this geographical area requires substantiation. Several species recorded by Wilson (1950) have not been observed by subsequent investigators, while other identifications given by this author are of questionable validity (C.C. Davis pers. comm.; C.T. Shih, pers. comm.) (see also Shih et al., 1971). Species whose occurrence in coastal British Columbia waters could not be verified have been omitted from the manual. These species are listed in Table 1. The format of the key allows updating with minimal revision as zooplankton sampling programs are expanded and extended into new geographical areas (e.g. the coastal waters west of Vancouver Island, Dixon Entrance, and certain coastal fjords).

Geographic Limits

The key applies to copepods found in the nearshore area extending from Dixon Entrance in the north to the Strait of Juan de Fuca in the south, and includes all major coastal inlets studied to date (Fig. 1). Major nearshore areas of the continental shelf, such as Queen Charlotte Sound, are also included.

Methodology

Species described herein have either been collected and identified at the Ocean Ecology Laboratory (Institute of Ocean Sciences, Sidney, B.C.) or previously recorded from the area (e.g. Fulton, 1972; Stone, 1977; Chester et al., 1980). Oceanic species occasionally recorded in nearshore areas following intrusions of oceanic water (e.g. Stone, 1980; Gardner, 1982a, 1982b) have also been included, and are described from the literature.

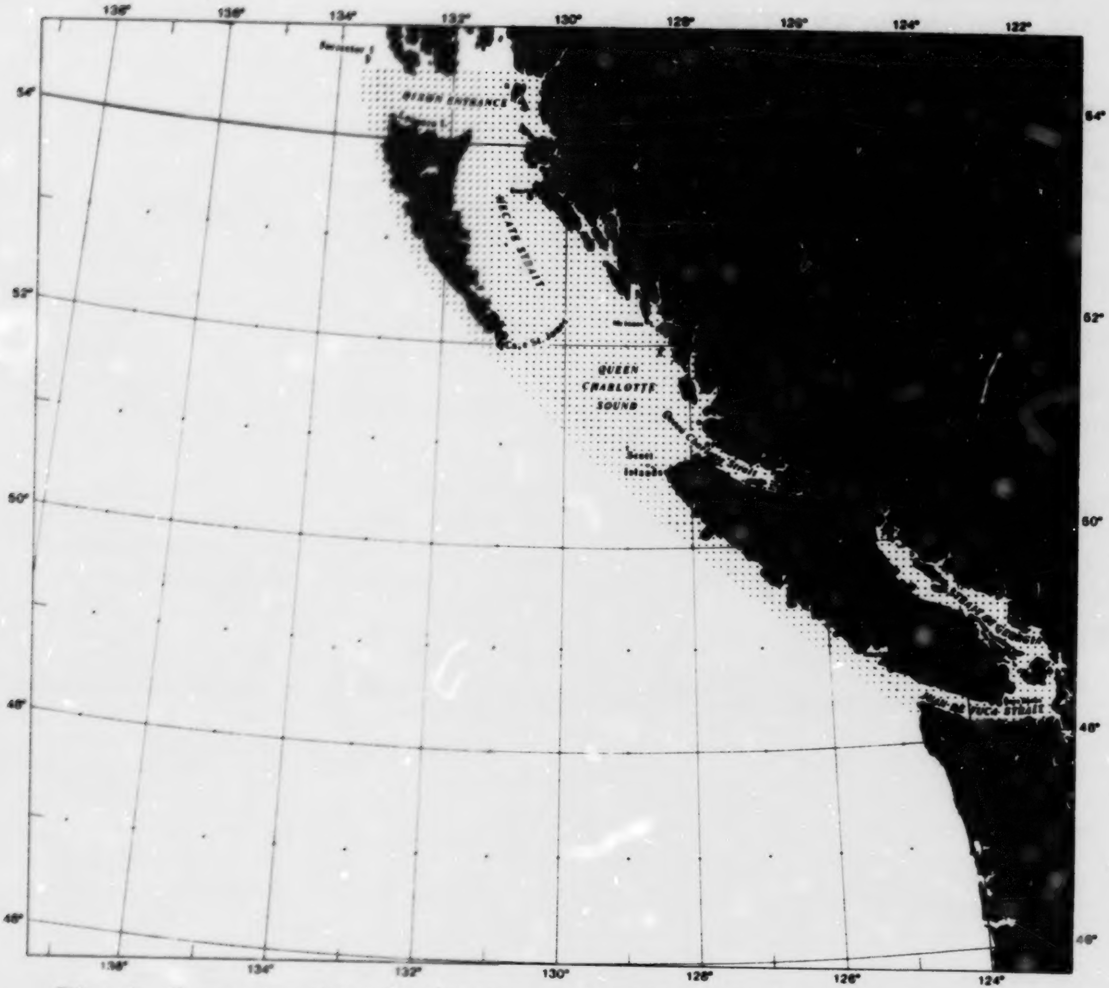

138°
136°
134°
132°
130°
128°
126°
124°
122°
54°
52°
50°
48°
46°
DIXON ENTRANCE
HECATE STRAIT
QUEEN CHARLOTTE SOUND
Scott Islands
Queen Charlotte Strait
STRAIT OF GEORGIA
JUAN DE FUCA STRAIT

Fig. 1. Geographical limits of British Columbia coastal waters as defined by the authors.

Table I: Species reported from only a single collection taken from the study area, and for which identifications cannot be confirmed. These species have been omitted from the key.

Family Species	Local citation	Comments
Calanidae		
Calanus minor (Claus, 1863)	Wilson, 1950	= *Nannocalanus minor*
Canthocalanus pauper (Giesbrecht, 1888)	Wilson, 1950	tropical, subtropical (Tanaka, 1956a)
Eucalanidae		
Eucalanus attenuatus (Dana, 1849)	Wilson, 1950	tropical (Fleminger, 1973
E. monachus Giesbrecht, 1888	Wilson, 1950	tropical, sub-tropical (Fleminger, 1973)
Paracalanidae		
Acrocalanus gibber Giesbrecht, 1888	Wilson, 1950	tropical (Mori, 1937)
A. gracilis Giesbrecht, 1888	Wilson, 1950	tropical and sub-tropical (Tanaka, 1956b)
Aetideidae		
Aetideopsis multiserrata (Wolfenden, 1904)	Davis, 1949b	uncertain ID (Vervoort, 1963)
Gaidius brevispinus (Sars, 1900)	Wilson, 1950	possible wrong ID Shih et al., 1971)
Euchaetidae		
Euchaeta erebi (Farran, 1929)	Wilson, 1950	possible wrong ID (Shih et al., 1971)
E. marina (Prestandrea, 1833)	Wilson, 1950	Atlantic, Mediterranean (Bradford, 1974)
E. norvegica (Boeck, 1872)	Wilson, 1950	only Pacific record
E. propinqua Esterly, 1906	Davis, 1949b	Davis' specimens are much smaller than Esterly's
Scolecithricidae		
Scolecithricella dentata (Giesbrecht, 1892)	Davis, 1949b	
Amallothrix inornata (Esterly, 1906)	Chester et al., 1980	a few juveniles reported from Strait of Juan de Fuca

Centropagidae		
Centropages calaninus (Dana, 1849)	Wilson, 1950	tropical (Mori, 1937)
Corycaeidae		
Corycaeus ovalis Claus, 1863	Wilson, 1950	tropical (Rose, 1933)
C. speciosus (Dana, 1852)	Wilson, 1950	warm water species (Mori, 1937)
Farranula gracilis (Dana, 1853)	Wilson, 1950	? *Corycaeus* sp.
F. rostrata (Claus, 1863)	Wilson, 1950	? *Corycaeus* sp.
F. gibbula (Giesbrecht, 1892)	Wilson, 1950	? *Corycaeus* sp.
Sapphirinidae		
Sapphirina scarlata Giesbrecht, 1892	Wilson, 1950	
Oncaeidae		
Oncaea similis Sars, 1918	Wilson, 1950	northeastern Atlantic (Rose, 1933)
Aegisthidae		
Aegisthus mucronatus Giesbrecht, 1891	Chester et al., 1980	a few juveniles reported from Strait of Juan de Fuca

Every attempt has been made to include all species reported from the study area. However, the paucity of zooplankton sampling in some areas (e.g. the entire continental shelf west of Vancouver Island until recently) imposes limitations on the scope of the manual. Because there is a strong probability of additional species (e.g. new species or range extensions) being found in the study area in the future, the key is constructed to allow easy insertion of additional descriptions.

Many of the genera included in the key are in need of revision (e.g. Pseudocalanus, Acartia). However, our primary intent was not to resolve taxonomic questions but to provide a simple effective key to local species as they are currently defined. Areas where more detailed taxonomic study is required or is underway are indicated.

In many species of free living Copepoda it is possible to recognize the basic morphology of the adult (or CVI stage) at the CV stage and, to a lesser extent, at the CIV stage. Because species of copepods may spend up to eight months as CV copepodites (see Fulton, 1973) the specific identification of these stages may be of great importance to ecological studies. When possible, the key presented in this manual has been designed to permit identification of CVI, CV, and usually CIV stage copepodites.

For each species included in the key we have presented recognized synonyms used in establishing records from British Columbia coastal waters. Additionally, synonomies recognized in major taxonomic studies are also included.

Copepod Morphology and Systematics

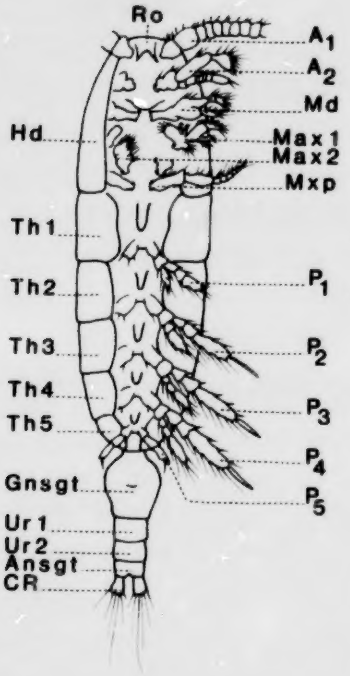
The taxonomic status of the Copepoda varies with the classification system used, ranging from class to subclass to order. Similarly, seven to nine orders (or sub-orders) are defined within the Copepoda. We consider Copepoda to be a class, a view adopted by several authors (e.g.

Kastner, 1970; George and George, 1979) and supported by the recent phylogenetic studies of Manton (1973, 1977). This manual deals only with the four orders containing species whose free living adults are pelagic: the Calanoida, Cyclopoida, Harpacticoida, and Monstrilloida. Of these the Calanoida is the best known order and is usually dominant in marine plankton. Cyclopoids are less well known and are primarily benthic, but have several planktonic genera. Harpacticoids are almost exclusively benthic, with only two species commonly found in the local plankton. Monstrilloids are highly modified, with a free-swimming adult and larval stages that are internal parasites of polychaetes and molluscs.

Because the majority of the pelagic, marine copepods found in British Columbia waters are calanoids, the basic morphology of members of this order will be described in some detail. The other orders will be described briefly, with discussion of differences among the four orders. Although morphological terminology varies in the literature, the predominant names were selected to provide uniformity, and alternate systems are shown for purposes of comparison (Fig. 2).

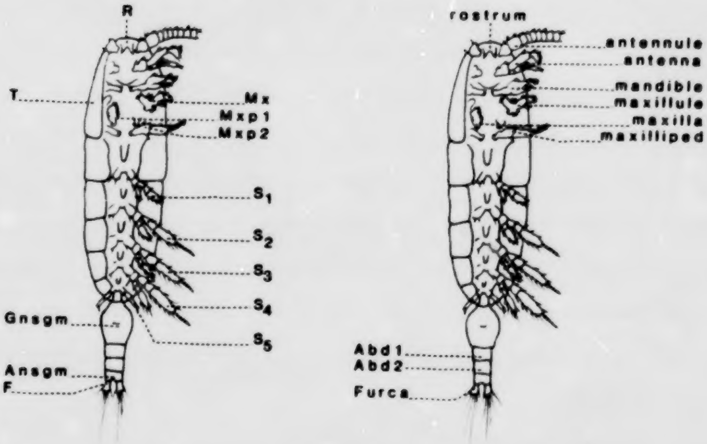
The morphology of calanoid copepods is typified by the adult of the genus Calanus (Fig. 2). The body is segmented, with a single articulation dividing the prosome (Pro) from the urosome (Ur). The prosome is composed of a head region (Hd) followed by three to five thoracic segments (Th1-Th5), with the first complete segment always called the Th1. As a result of the fusion of the head and first thoracic segment the first pair of swimming legs (P1) originates within the head region. Similarly, the presence of two sets of swimming leggs within the last thoracic segment is a result of the fusion of segments, common in calanoids and cyclopoids.

Fig.2


Ro
A1
A2
Md
Max 1
Max 2
Mxp
Hd
Th1
Th2
Th3
Th4
Th5
P1
P2
P3
P4
P5
Gnsgt
Ur 1
Ur 2
Ansgt
CR

Calanoid morphological terminology.

from Owre and Foyo, 1967


R
T
Mx
Mxp 1
Mxp 2
S1
S2
S3
S4
S5
Gnsgm
Ansgm
F
rostrum
antennule
antenna
mandible
maxillule
maxilla
maxilliped
Abd1
Abd2
Furca

Differences in calanoid morphological terminology.

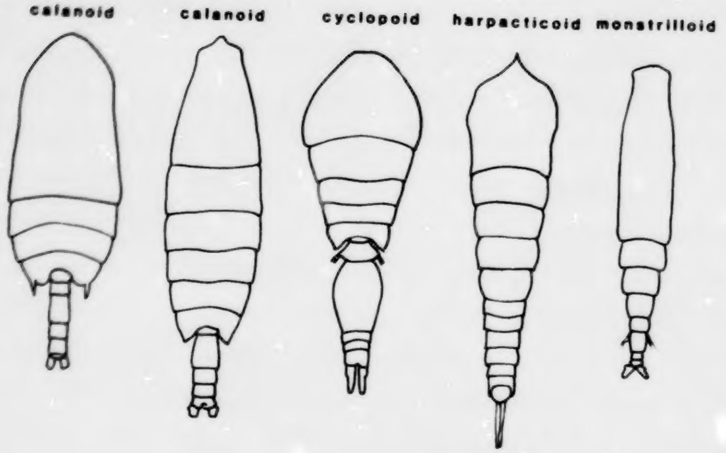
from Owre and Foyo, 1967

Posterior to the articulation lies a slender urosome (Ur), which bears no swimming appendages. The number of segments in the urosome varies with life history stage and sex. Its proximal and distal segments are modified, with the proximal containing the genital pore and referred to as the genital segment (gnsgt). In females the genital segment is composed of two fused segments and bears one or more ventral symmetrical or asymmertical protuberances, the number and arrangement of which are usually genera or species specific. In males, the genital segment is short, unfused, and possesses a smooth ventral surface which is of little taxonomic significance. The anal segment (ansgt), the most distal segment of the urosome, bears the anus. On the posterior margin of the anal segment two single segmented caudal rami (Cr) are attached. Each bears four or five long, stout setae with secondary (and occasionally tertiary) setules. The caudal rami may have small setae along their medial margins. The urosomal segments, located between the genital and anal segments, are numbered sequentially. Females typically have a total of four urosomal segments (gnsgt, Ur1, Ur2, ansgt) and males have five (gnsgt, Ur1, Ur2, Ur3, ansgt).

The shapes of the prosome and urosome are often characteristic. For example, some Calanus species can be separated by head profile (prosome) differences. The head may or may not bear a rostrum (Ro), which is often of characteristic shape. Many species have characteristic spines or blunt processes at the posterior corners of the prosome, while in others the caudal rami may differ in length, shape or armature.

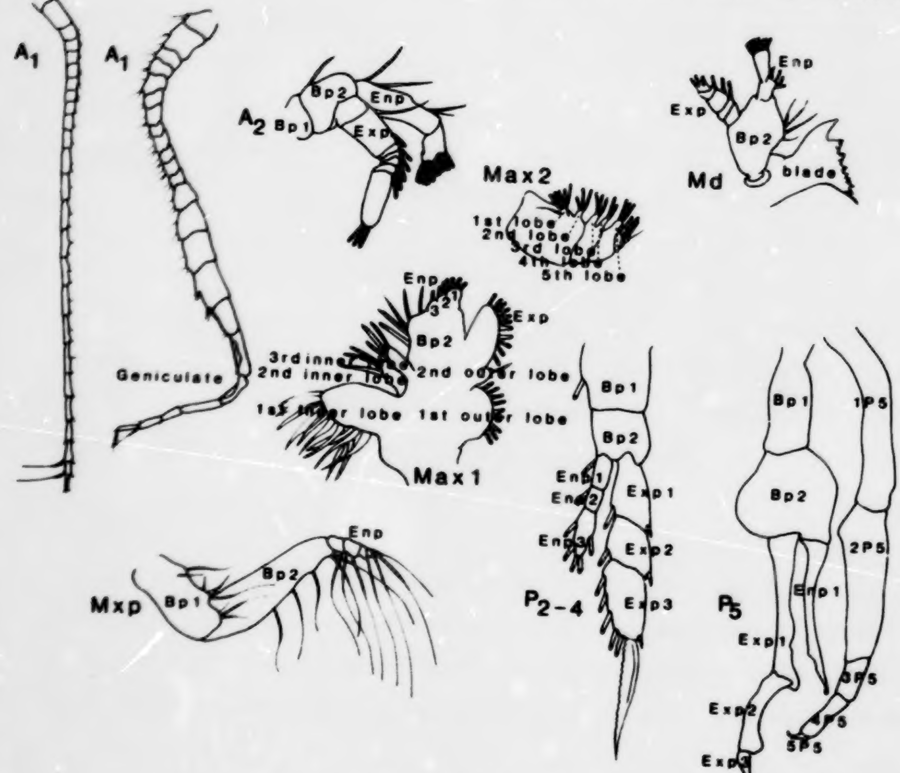
Several paired appendages are identifiable (Figs. 2, 3). These appendages normally have the same basic structure in all calanoids, but differ in minor characteristics which commonly are diagnostic of different genera or species. The most anterior paired appendages are the first

Fig.3


calanoid
calanoid
cyclopoid
harpacticoid
monstrilloid

Generalized copepod body shapes.

from Sars,1921; Owre and Foyo,1967


A1
A1
Geniculate
A2
Bp1
Bp2
Enp
Exp
Max2
1st lobe
2nd lobe
3rd lobe
4th lobe
5th lobe
Exp
Enp
Bp2
Md
blade
Enp
3
2
1
Exp
Bp2
3rd inner lobe
2nd inner lobe
2nd outer lobe
1st inner lobe
1st outer lobe
Max1
Mxp
Bp1
Bp2
Enp
Bp1
Bp2
Enp1
Enp2
Enp3
Exp1
Exp2
Exp3
P2-4
Bp1
Bp2
1P5
2P5
Enp1
P5
Exp1
Exp2
Exp3
3P5
4P5
5P5

Calanoid appendages (not drawn to scale).

from Owre and Foyo,1967, Vervoort,1968

antennae (A1), which may vary between species in number of segments, arrangement of setae on the segments, and relative length. The second antennae (A2), mandibles (md), first maxillae (maxl), second maxillae (max2) and maxillipeds (mxp) complete the head appendages, and are often collectively termed feeding appendages as they all contribute to food gathering and processing.

The thorax bears up to five paired swimming legs (P1-P5) with each leg having two basal segments, the basipodites (bpl, bp2). The distal basipodite carries two rami, an outer exopodite (exp) and an inner endopodite (enp), each consisting of a variable number of segments depending on species and life history stage. The morphology of the fifth pair of legs varies considerably, being frequently absent in some females, and always dissimilar in males and females of the same species. When present, the P5's may be uniramous, biramous, or occasionally chelate in males. Younger stages do not have all the swimming legs (e.g. Table 2).

Table 2

Pairs of swimming legs and number of urosomal segments in successive Calanus copepodite stages

Stage	Pairs of legs	Urosome segments
CI	2	1
CII	3	2
CIII	4	2
CIV	5	3
CV	5*	4
CVIf	5*	4
CVIm	5	5

* P5 of CV and CVI females often absent in other genera, allowing easier recognition of sexes in these stages.

Differentation between species is often based on the armature of the appendages. Armature may include such characters as teeth, spines, spinules, blades, setae, and setules (see Glossary). The function of the appendages is discussed by Marshall and Orr (1955), Brodsky (1950), Marshall (1973) and others.

The other orders included in this manual are readily separable from the Calanoida. Cyclopoid copepods have a relatively broad prosome and a narrow urosome. The A1 are usually shorter than the prosome, and the A2 are uniramous, resulting in a jerky swimming motion. The articulation is not as distinct as in the calanoids, and lies between Th4 and Th5, with the result that the P5 are carried on the first segment posterior to the articulation, and may be reduced and difficult to see. The female often carries eggs in two ovisacs located externally on either side of the genital segment.

Harpacticoids have a biramous A2 (as do calanoids) but the major articulation between Th4 and Th5 (as in cyclopoids) is much less distinct and the urosome is often as broad as the prosome. The A1 are much reduced, being composed of nine or fewer segments, and is typically shorter than the head region. Eggs are usually contained in a single ovisac carried medially on the genital segment.

Monstrilloids are the most highly modified copepod order found in the plankton. The adults are non-feeding and all appendages between the A1 and P1 are lacking. The A1 are usually short and project forward. The major articulation is not pronounced.

Copepod Life Histories

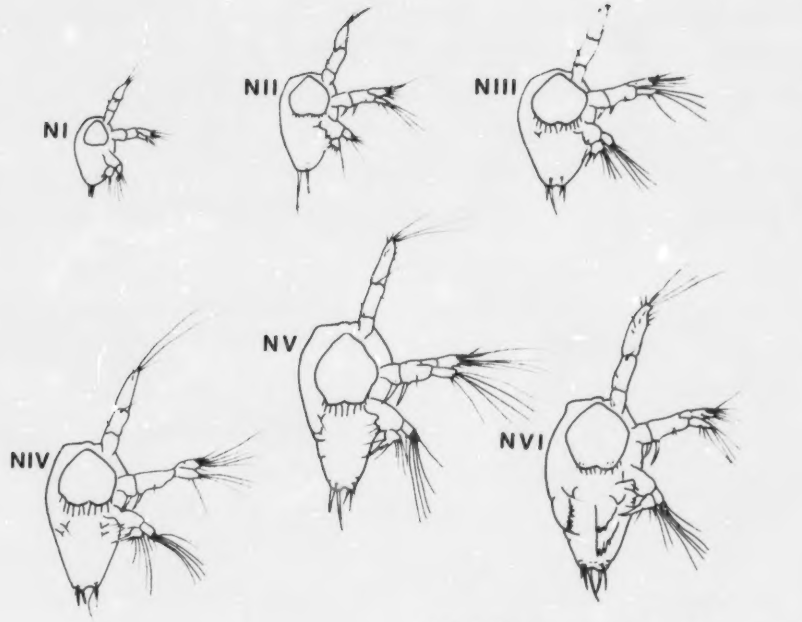
Copepods commonly appear in samples as juvenile stages and the differentiation and identification of species by life history stage can be difficult. A generalized life history of copepods which will assist in identifications is provided below. More complete information may be found in Marshall and Orr (1955) or in advanced texts in invertebrate zoology.

Development proceeds from an egg, which may be single or part of a cluster, through six successive naupliar stages (NI-NVI) (Fig. 4). In some species, earlier naupliar stages occur within the egg, but in others the NI is free-swimming. The sixth nauplius metamorphoses into the first copepodite stage (CI), which is similar to the adult but commonly has only two pairs of legs and one or two abdominal segments. Molting continues through a series of copepodite stages to the sixth and final stage, the adult (CVI) (Fig. 5). Males and females can be distinguished in the CVI by the number and extent of development of the urosomal segments and the degree of development of the P5. The absence of the P5 in some CV and even CIV is a confirmatory female characteristic.

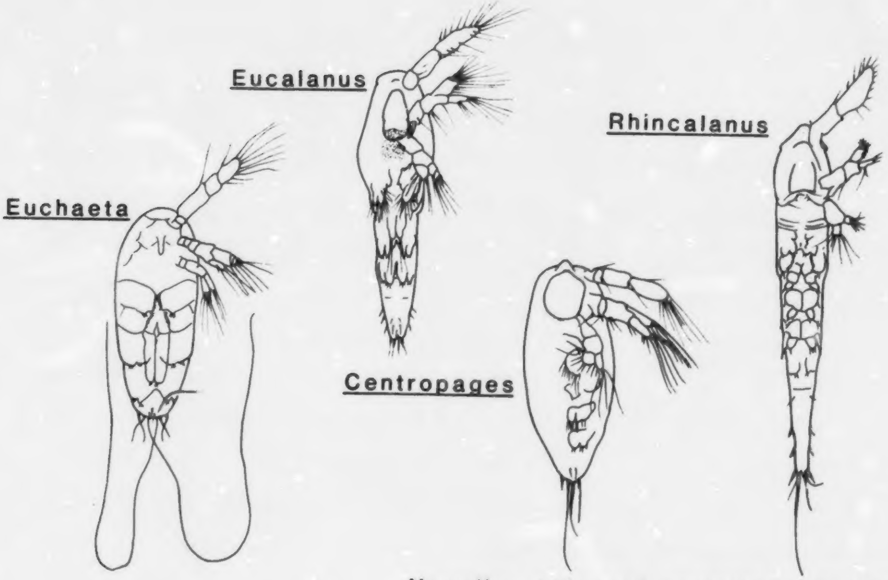
Although most nauplii are poorly known, their relative stage may be established by shape, size, and presence or absence of certain appendages. Species identification solely from nauplii has rarely been attempted, although Faber (1966) presented a key to the nauplii of 14 species found in Narragansett Bay, Rhode Island.

Copepodite stages are typically recognized by the number of segments in the urosome and the number of pairs of swimming legs (e.g. Table 2). These numbers are not constant for all species, but variations are minor. Fulton (1972) tabulates the size, number of pairs of legs, and number of urosomal segments for nine common calanoid species. The developmental patterns of marine cyclopoids and harpacticoids are thought to follow the same general pattern.

Fig.4


NI
NII
NIII
NIV
NV
NVI

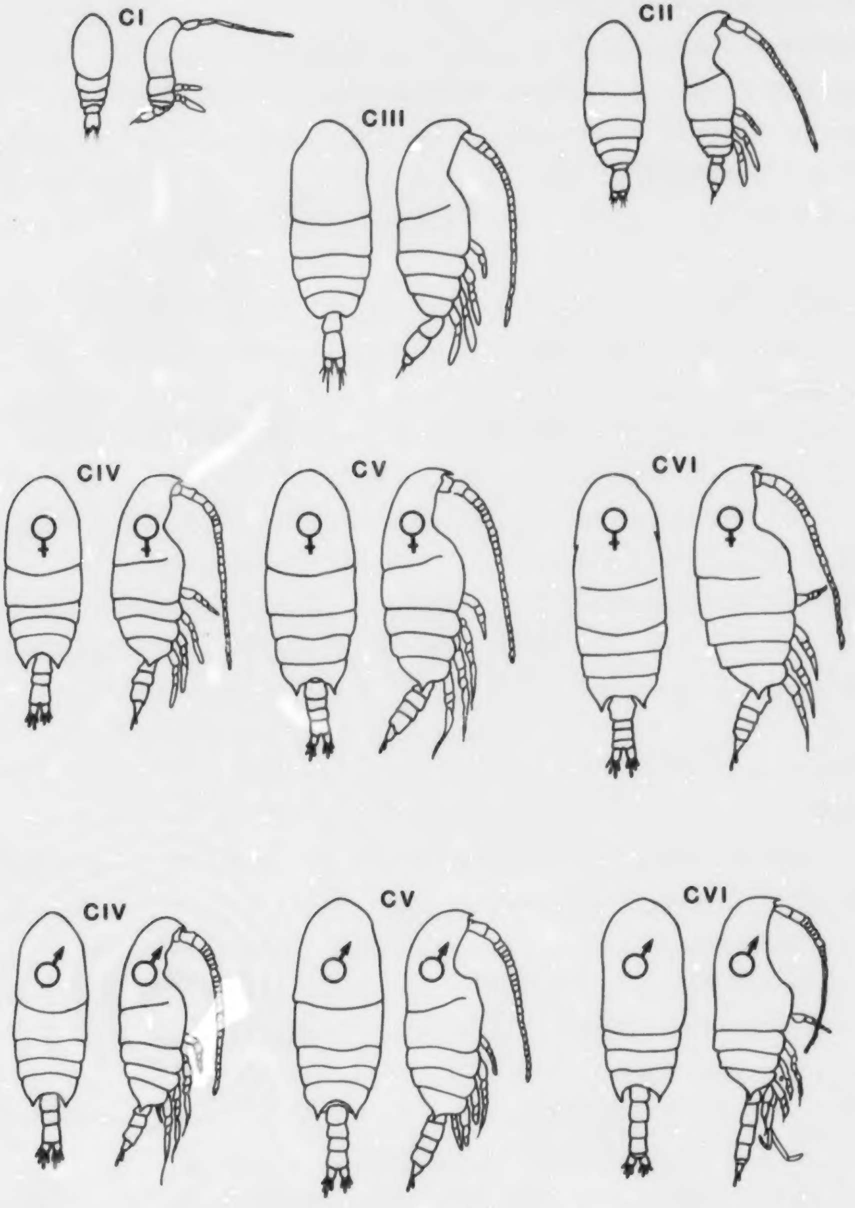
Naupliar stages in Tortanus


Eucalanus
Rhincalanus
Euchaeta
Centropages

Naupliar calanoid variations in NVI.

from Gurney,1934; Johnson,1942; Bernard,1965; Lawson and Grice,1970

Fig.5


CI
CII
CIII
CIV
♀
CV
♀
CVI
♀
CIV
♂
CV
♂
CVI
♂

Copepodite stages in *Bradyidius*.

from Shih et al.,1981

Regardless of order, adult males and females of the species included in this manual can usually be distinguished by a few salient features. In addition to differences in number of urosomal segments and pairs of swimming legs (see Table 2), adult females may often be recognized by the presence of an elongate or robust gnsgt bearing one to several ventral protuberances and by the presence of spermathecae or ovisacs. Adult males occasionally have a bulbous and/or articulate AI on either or both sides.

Generation time and growth rate vary considerably among species. In some species, the females produce several egg clutches in less than a week, other species lay only a single clutch, while others lay a series of single eggs before dying. Life spans range from one week to two years (see, for example, Digby, 1954; Heinle, 1966). In general, smaller species (e.g. Pseudocalanus spp., Oithona spp.) tend to be shorter-lived, producing several successive generations annually, while larger copepods (e.g. Calanus spp., Neocalanus spp.) tend to live longer, often having annual life cycles (see Campbell, 1934; Fulton 1973).

Format and Use

The manual consists of a key to species followed by detailed species descriptions. Descriptions include pertinent illustrations, synonymies, major references, size ranges, ecological information on dominant species, and information on life history stages as available. An extensive ancillary list of references relevant to local copepod species has been included as a separate bibliography (see Part II).

Figures used in the species descriptions were obtained from various published sources and are drawn in standardized format. As far as possible, each figure consists of a basic set of drawings including dorsal and lateral views of the adult male and female, all female swimming legs (P1-P4), and fifth legs (P5) of both the adult male and female. Where possible, illustrations of feeding appendages have been included when these appendages have been used to distinguish taxa. To indicate their relative sizes, the first antennae (A1) and P5 are often included in lateral view of entire specimens, but all other appendages are omitted. Other drawings, such as an enlarged view of the urosome or genital segment, are included where appropriate. Separate body parts are drawn in ventral view unless otherwise indicated. In the upper left of each figure, a 1.0 mm scale bar is provided which refers only to drawings of whole specimens, not to individually figured appendages.

The key is initiated by separating the free-swimming copepods into orders. Harpacticoida and Monstrilloida are the smallest orders, being represented by only a few species occurring in the local zooplankton. The order Cyclopoida is considerably larger, and includes some species which are occasionally abundant in the plankton. The fourth order, Calanoida, constitutes the bulk of nearshore zooplankton and comprises the largest taxonomic section.

Before using the manual, it is advisable to become familiar with the scope and format of the tabular key. To identify a specimen, try to establish the sex and, if possible, the developmental stage (see Table 2). Although not essential, this will facilitate use of the tabular key.

Species identification is based upon a series of key groups (KG's). Each key group contains characters describing the specimens being examined. By selecting the correct characters, it is possible to establish a character sequence, analogous to a 'formula' describing the specimen. This character sequence is then compared with a list of all possible character sequences given on the same page and a matching sequence identified. This matching sequence will direct you to another KG which may immediately identify the specimen or, more likely, present you with another level of characters. Following successive KG's will eventually provide a tentative species identification which must be confirmed by comparison of the specimen with the generic and species description.

Three general symbols are used in the key. A '+' symbol indicates that any of the alternative answers are correct for a particular character; '?' indicates unknown; and '#' indicates that the character does not apply in this case.

The following example will clarify the use of a tabular key. Assume you are starting with an adult copepod of unknown order:

1) Go to KG1

Using the list of characters, we find that our specimen has five pairs of cephalic appendages, a short A1 with 12-15 segments, a uniramous A2 and a narrow urosome. This gives us a character sequence of 'y + u n', corresponding to the second character sequence listed in KG1. The '+' symbol in the key indicates that any of the alternative answers for character II are correct. This sequence sends us to KG 4, Cyclopoida.

2) Go to KG4

Our specimen has an elongate prosome, elongate urosome, short A1, lacks cuticular lenses, and has a three-segmented exp and enp in the P4, for a character sequence of 'e l s n 3-3', corresponding to the fourth character sequence, which sends us to KG 20. Note that in this case, the second character, urosome length, is not relevant to the selection of the correct key group.

3) Go to KG 20

Here, there are only three characters. Our specimen has a seta on the distal inner margin of the P2 bp1, has two spines on the P2 exp3 and has a short gnsgt. This character sequence conforms to Lubbockia wilsonae.

Once a tentative identification is made, the species description in the second part of the key must be considered for verification. If a discrepancy exists which cannot be attributed to difference in stage or sex, the process of identification must be repeated. Some alternative character states may initially be difficult to differentiate, however the generic descriptions indicate morphologically similar species which may be confused.

Summary

This manual includes all calanoid, cyclopoid, and monstrilloid copepods, as well as the only two common planktonic harpacticoids, reported from the study area to date. It is expected that the species list will increase with more intensive sampling of such areas as coastal fjords and the northernmost sections of the British Columbia coast. The use of nets with small mesh size will permit better collections of smaller copepods and younger life history stages which are presently undersampled. The use of different types of sampling gear will increase our knowledge of specialized environments such as the suprabenthos and the neuston, both of which have not been extensively studied. The additional new species will be incorporated in revisions of the manual.

Present taxonomic keys generally rely on adult characteristics. We have, whenever possible, selected characters relevant to juvenile as well as adult specimens, verifying the relevance of chosen characters to juveniles where juvenile stages have been described. This manual is designed to evolve in relation to our increasing knowledge of marine zooplankton communities and can incorporate new life history data for local species as such information becomes available.

Glossary

aesthetasc	elongate sensory setae often found on the first antennae
anal segment (ansgt)	terminal segment of urosome, often reduced, which bears the anal pore
antennae (A1, A2)	movable, paired, segmented sensory and locomotory organs on head
apical	at, near, or pertaining to the apex
armature	protective, sometimes spinous projections of the cuticle
articulation	movable joint or plate where two parts or segments are joined
basipodite (bp)	first one or two proximal segments of a biramous appendage
bifid	divided into two
blade	broad, flat structure; modified spine
bristle	short, stiff hair
carapace	hard cuticular shell covering the body
caudal rami (Cr)	a pair of one-segmented appendages attached to the ansgt and bearing the caudal setae
cephalic	pertaining to the head region
cephalosome	head region

cephalothorax	see prosome
chela	pincer-like claw
chelate	having a pincer-like claw
clavate	club-shaped; thickening gradually toward the tip
copepodites	life history stages (usually 6) which follow metamorphosis of the last naupliar stage and all of which resemble the adult
crest	a prominent, longitudinal ridge or keel usually associated with the apex of the cephalosome
cristate	having a crest
cuticle	outermost layer of the integument, forming the exoskeleton
cusp	pointed process resembling a sharp tooth
cuticular lens	lens-shaped thickening of cuticle on the cephalosome of some species and resembling eyes; function unknown
denticle	small tooth
denticulate	set with small teeth
dimorphic	occurring in two distinct forms
distal	away from or furthest from the point of origin
endopodite (end)	the inner branch of a biramous limb, closest to the mid-line of the body
exopodite (exp)	the outer branch of a biramous limb, furthest from the mid-line of the body
falcate/falciform	sickle-shaped, long and curved
filament	slender, thread-like cuticular projection
fusiform	spindle-shaped, broad at the midpoint and narrowing towards the ends
geniculate	having a knee-like joint which allows bending at acute angles

genital segment (gnsgt)	first segment of urosome bearing the genital aperture, often with hairs, spines, flanges, or bulges
labrum	upper lip covering the mouth opening
mandibles (md)	the first pair of mouthparts posterior to the antennae
maxillae (max1, max2)	two pairs of mouthparts (max1, max2) between the mandibles and maxillipeds
maxillipeds (mxp)	pair of appendages following the second maxillae and preceeding the first pair of swimming legs
nauplii	pre-metamorphic larval stages (usually 6) characterized by a swollen cephalothorax and reduced appendages
ornamentation	presence of spines, hairs, or setae
ovisac	a casing, usually attached to the genital segment, which contains the fertilized eggs
papilla	small, blunt projection
process	rigid outgrowth or projection
prosome (pro)	the combined head and thorax, anterior to the point of articulation of the urosome
proximal	closest to the point of origin
pterygoid	wing-like; broad and expanded
ramus (pl. rami)	branch composed of one or more segments
raptorial	adapted for seizing prey
rostrum	beak-like prolongation of the head
serrate/serrulated	saw-like, finely denticulate
seta	elongate bristle
setose	covered with setae
setule	small, blunt seta often borne on a larger seta
setulose	covered with setules

spine	thorn-like projection with a defined point of attachment to the body
spiniform	drawn out to an acute point; in the shape of a spine
spinulation	covering of small spines
spinule	small spine
spinulose	set with small spines
styliform	ending in a long, slender point
subequal	approximately equal
teeth	short, hard, pointed processes arising from an appendage or margin
thorax (Th)	the middle body region bearing the swimming legs
total length (TL)	distance between apex of head and distal margin of caudal rami
uncinate	hooked
urosome (Ur)	the abdomen; that portion of the body posterior to the major articulation including the genital segment
vaulted	arched
vermiform	worm-like; long and thin

SPECIES LIST

Order Harpacticoida

Family Ectinosomidae

1.1.1 *Microsetella norvegica* (Boeck, 1864)
1.1.2 *M. rosea* (Dana, 1852)

Order Monstrilloida

Family Monstrillidae

2.1.1 *Monstrilla canadensis* McMurrich, 1917
2.1.2 *M. helgolandica* Claus, 1863
2.1.3 *M. longiremis* Giesbrecht, 1892
2.1.4 *M. spinosa* Park, 1967
2.1.5 *M. wandelii* Stephensen, 1913

Order Cyclopoida

Family Ascomyzontidae

3.1.1 *Ascomyzon rubrum* Campbell, 1929

Family Corycaeidae

4.1.1 *Corycaeus anglicus* Lubbock, 1857
4.1.2 *C. catus* Dahl, 1894

Family Lichomolgidae

5.1.1 *Macrocheiron sargassi* Sars, 1916

Family Oithonidae

6.1.1 *Oithona similis* Claus, 1863
6.1.2 *O. spinirostris* Claus, 1863

Family Oncaeidae

7.1.1 *Oncaea borealis* Sars, 1918
7.1.2 *O. conifera* Giesbrecht, 1891
7.1.3 *O. englishi* Heron, 1977
7.1.4 *O. ivlevi* Shmeleva, 1966
7.1.5 *O. prolata* Heron, 1977
7.2.1 *Lubbockia minuta* Wolfenden, 1905
7.2.2 *L. wilsonae* Heron and Damkaer, 1969
7.3.1 *Pseudolubbockia dilatata* Sars, 1909

Order Calanoida

Family Calanidae

8.1.1	*Calanus marshallae* Frost, 1974
8.1.2	*C. pacificus* s.l. Brodsky, 1948
8.2.1	*Neocalanus cristatus* (Kroyer, 1848)
8.2.1	*N. plumchrus* (Marukawa, 1921)
8.3.1	*Mesocalanus tenuicornis* (Dana, 1849)

Family Eucalanidae

9.1.1	*Eucalanus bungii* Giesbrecht, 1892
9.1.2	*E. californicus* Johnson, 1938
9.1.3	*E. hyalinus* (Claus, 1866)
9.2.1	*Rhincalanus nasutus* Giesbrecht, 1888

Family Calocalanidae

10.1.1	*Mecynocera clausi* Thompson, 1888
10.2.1	*Calocalanus styliremis* Giesbrecht, 1888

Family Paracalanidae

11.1.1	*Paracalanus parvus* (Claus, 1863)

Family Pseudocalanidae

12.1.1	*Pseudocalanus* cf. *minutus* (Kroyer, 1845)
12.2.1	*Microcalanus pygmaeus pusillus* Sars, 1903
12.3.1	*Clausocalanus arcuicornis* (Dana, 1849)
12.3.2	*C. lividus* Frost and Fleminger, 1968
12.3.3	*C. parapergens* Frost and Fleminger, 1968
12.4.1	*Ctenocalanus vanus* Giesbrecht, 1888

Family Spinocalanidae

13.1.1	*Spinocalanus brevicaudatus* Brodsky, 1950
13.1.2	*S. horridus* Wolfenden, 1911
13.1.3	*S. longicornis* Sars, 1900

Family Aetideidae

14.1.1	*Aetideus divergens* Bradford, 1971
14.1.2	*A. pacificus* Brodsky, 1950
14.2.1	*Bradyidius saanichi* Park, 1966
14.2.2	*B. similis* (Sars, 1903)
14.3.1	*Chiridius gracilis* Farran, 1908
14.3.2	*C. polaris* Wolfenden, 1911
14.4.1	*Gaidus minutus* Sars, 1907
14.4.2	*G. pungens* Giesbrecht, 1895
14.4.3	*G. variabilis* Brodsky, 1950

14.5.1 *Gaetanus intermedius* Campbell, 1930
14.5.2 *G. miles* Giesbrecht, 1888
14.5.3 *G. pileatus* Farran, 1903
14.6.1 *Euchirella curticauda* Giesbrecht, 1888
14.6.2 *E. pulchra* (Lubbock, 1856)
14.6.3 *E. pseudopulchra* Park, 1976
14.6.4 *E. rostrata* (Claus, 1866)
14.7.1 *Chirundina streetsi* Giesbrecht, 1895
14.8.1 *Undeuchaeta bispinosa* Esterly, 1911
14.9.1 *Pseudochirella polyspina* Brodsky, 1950
14.10.1 *Azygokeras columbiae* Koeller and Littlepage, 1976

Family Euchaetidae

15.1.1 *Euchaeta californica* Esterly, 1906
15.1.2 *E. elongata* Esterly, 1913
15.1.3 *E. media* Giesbrecht, 1888
15.1.4 *E. spinosa* Giesbrecht, 1892

Family Phanennidae

16.1.1 *Onchocalanus magnus* (Wolfenden, 1906)

Family Scolecithricidae

17.1.1 *Scottocalanus persecans* (Giesbrecht, 1895)
17.2.1 *Lophothrix frontalis* Giesbrecht, 1895
17.3.1 *Scaphocalanus affinis* (Sars, 1905)
17.3.2 *S. brevicornis* Sars, 1900
17.3.3 *S. echinatus* Farran, 1905
17.3.4 *S. magnus* (T. Scott, 1894)
17.3.5 *S. major* (T. Scott, 1894)
17.3.6 *S. subbrevicornis* (Wolfenden, 1911)
17.4.1 *Racovitzanus antarcticus* Giesbrecht, 1902
17.5.1 *Scolecithricella emarginata* (Farran, 1905)
17.5.2 *S. minor* (Brady, 1883)
17.5.3 *S. subdentata* (Esterly, 1905)
17.5.4 *S. ovata* (Farran, 1905)

Family Tharybidae

18.1.1 *Tharybis fultoni* Park, 1967

Family Temoridae

19.1.1 *Eurytemora affinis* (Poppe, 1880)
19.1.2 *E. americana* Williams, 1906
19.1.3 *E. pacifica* Sato, 1913

Family Metridiidae

20.1.1 *Metridia curticauda* Giesbrecht, 1889
20.1.2 *M. lucens* s.l. Boeck, 1864
20.1.3 *M. okhotensis* Brodsky, 1950
20.1.4 *M. pacifica* Brodsky, 1950
20.1.5 *M. princeps* Giesbrecht, 1889
20.2.1 *Pleuromamma abdominalis* (Lubbock, 1856)
20.2.2 *P. borealis* (Dahl, 1893)
20.2.3 *P. quadrungulata* (Dahl, 1893)
20.2.4 *P. robusta* (Dahl, 1893)
20.2.5 *P. scutullata* Brodsky, 1950
20.2.6 *P. xiphias* (Giesbrecht, 1889)
20.3.1 *Gaussia princeps* (T. Scott, 1894)

Family Centropagidae

21.1.1 *Centropages abdominalis* Sato, 1913

Family Lucicutiidae

22.1.1 *Lucicutia bicornuta* Wolfenden, 1905
22.1.2 *L. flavicornis* (Claus, 1863)
22.1.3 *L. ovalis* (Giesbrecht, 1889)

Family Heterorhabdidae

23.1.1 *Heterorhabdus clausi* (Giesbrecht, 1889)
23.1.2 *H. papilliger* (Claus, 1863)
23.1.3 *H. robustoides* Brodsky, 1950
23.1.4 *H. robustus* Farran, 1908
23.1.5 *H. spinifrons* (Claus, 1863)
23.1.6 *H. tanneri* (Giesbrecht, 1895)
23.2.1 *Heterostylites longicornis* (Giesbrecht, 1889)
23.2.2 *H. major* (Dahl, 1894)

Family Augaptilidae

24.1.1 *Centraugaptilus porcellus* Johnson, 1936
24.2.1 *Haloptilus oxycephalus* (Giesbrecht, 1889)
24.3.1 *Pachyptilus pacificus* Johnson, 1936

Family Arietellidae

25.1.1 *Arietellus plumifer* Sars, 1905
25.2.1 *Phyllopus integer* Esterly, 1911

Family Candaciidae

26.1.1 *Candacia bipinnata* (Giesbrecht, 1889)
26.1.2 *C. columbiae* Campbell, 1929

Family Pontellidae

27.1.1 *Epilabidocera longipedata* (Sato, 1913)

Family Acartiidae

28.1.1 *Acartia* cf. *clausi* Giesbrecht, 1889
28.1.2 *A. danae* Giesbrecht, 1889
28.1.3 *A. longiremis* (Lilljeborg, 1853)
28.1.4 *A. californiensis* Trinast, 1976

Family Tortanidae

29.1.1 *Tortanus discaudatus* (Thompson and Scott, 1897)

2.0 KG I: KEY TO THE ORDERS OF COPEPODA

Basic features shared by all free-swimming copepods:

Crustaceans with a more or less cylindrical body bearing ventrally a series of paired trunk appendages. Anteriorly, these appendages, if present, are differentiated into a series of morphologically distinct feeding appendages; posteriorly, the appendages take the form of swimming legs, most of which are similar, although the fifth or hindmost pair in the adult may be modified or missing. An abdomen is separated from the trunk by an articulation which may be easily seen or may be obscured, depending on the taxonomic order of the specimen. The abdomen usually does not bear appendages, but in some orders may bear one very reduced pair of swimming legs. Total length ranges from approximately 0.20 mm to 10.0 mm.

KG I A key to the orders of copepods

Characters:

I. 2-5 pairs of appendages between A1 and P1 (y or n)

II. A1 with fifteen or more segments (y or n)

III. A2 biramous (b), uniramous (u) or absent (a)

IV. Ur distinctly narrower than Pro (narrow:n), or approximately equal in width (equal:e) (see Fig. 3)

Character sequence:

I	II	III	IV	KG	
y	n	b	e	2	HARPACTICOIDA
n	n	a	e	3	MONSTRILLOIDA
y	+	u	n	4	CYCLOPOIDA
y	y	b	n	5	CALANOIDA

3.0 KG 2: KEY TO THE HARPACTICOIDA

Harpacticoids are typically benthic but two of several planktonic species, Microsetella rosea and M. norvegica, occur in the local plankton and are described in this manual.

Characters:

I. Body fusiform, Hd narrowing to a broad point, P1 not visibly different than P2 - P4 without dissection (y or n)*

II. Long terminal seta of Ur only as long as TL (short:s) or 1.5xTL (long:l)

III. Two setae on inner lobe of fP5 subequal (eq), or one much longer (unequal:un)

IV. TL of male greater than 0.55 mm (y or n)

Character sequence:

I	II	III	IV	
y	y	un	n	Microsetella norvegica (1.1.1)
y	n	eq	y	M. rosea (1.1.2)

* if answer is no, consult Wells (1976)
** Male A1 modified as grasping organ: bulbous swelling about midlength

4.0 KG 3: KEY TO THE MONSTRILLOIDA

Only five members of this order have been reported from the British Columbia area, and all belong to the genus Monstrilla.

Characters:

- I. AI less than one-half length of cephalosome (y or n)
- II. Number of setae on each fP5
- III. Ro present (p) or absent (a)
- IV. Pair of conspicuous spines on the distal margins of Th1 and Th2 (y or n)
- V. AI with branched setae (b), articulated distal segment (a), or neither (n)

Character sequence:

I	II	III	IV	V	
y	2	a	n	n	Monstrilla helgolandica (2.1.2)
n	4	a	n	b	M. longiremis (2.1.3)
n	3	p	y	b	M. spinosa (2.1.4)
n	2	a	n	n	M. wandelii (2.1.5)
?	?	?	?	a	M. canadensis (2.1.1)

5.0 KG 4: ENTRY KEY TO THE CYCLOPOIDA

Characters:

I. Pro width to length ratio approximately 1.0 (broad:b) or much less than 1.0 (elongate:e)

II. Ur shorter than 1/3 TL (short:s) or equal to or longer than 1/3 TL (long: l)

III. Al extend to the posterior margin of Pro or farther (long:l), or are much shorter (short:s)

IV. Cuticular lenses visible in head region in dorsal or lateral view (y or n)

V. Prosome densely spinulose (y or n)

VI. Number of segments of P4 rami (exp-enp)

Character sequence:

I	II	III	IV	V	VI	KG	
b	s	s	n	n	?		Ascomyzon rubrum (3.1.1)
e	l	s	n	n	3-1		Macrocheiron sargassi (5.1.1)
e	l	s	n	n	3-2		M. sargassi (5.1.1)
e	l	s	n	y	3-3		Pseudolubbockia dilatata (7.3.1)
e	l	l	n	n	3-3	10	(Oithona)
e	+	s	n	n	3-3	20	
e	s	s	y	n	3-3	30	(Corycaeus)

5.1 Keys to the Cyclopoida

KG 10 (*Oithona*)

Characters:

I. Female Ro strong, anteriorly directed and visible in dorsal view (y or n)

II. Al do not extend beyond gnsgt (short:s) or reach ansgt (long:l)

III. Al genticulate (y or n)

IV. TL greater than 0.5 mm (y or n)

Character sequence:

I	II	III	IV	
n	s	n	y	*Oithona similis* (6.1.1)
y	l	n	y	*O. spinirostris* (6.1.2)
n	s	y	n	*O. similis* (male) (6.1.1)
n	s	y	y	*O. spinirostris* (male) (6.1.2)

KG 20

Characters:

I. First basipodite of PI-P4 with seta on distal inner margin (y or n)

II. Number of spines on outer edge of PI exp3 and P2 exp3

III. Length of gnsgt equal to combined length of remaining Ur segments (equal:e) or much shorter (short:s)

IV. Prosome densely spinulose (y or n)

Character sequence:

I	II	III	IV	KG	
n	#	e	n	21	(Oncaea)
y	2	s	n		Lubbockia wilsonae (7.2.2)
y	3	s	n		L. minuta (7.2.1)
y	3	s	y		Pseudolubbockia dilatata (7.3.1)

KG 21 (*Oncaea*)

Characters:

I. Female Th2 with dorsal projection visible in lateral view (y or n)

II. Female gnsgt much longer than remainder of Ur (long:l), or approximately equal to or shorter than remainder of Ur (short:s)

III. Female P5 short and oval (short:s) or elongate and rectangular (elongate:e)

IV. Distal corners of m gnsgt with pronounced lateral projections (pronounced:p) or with small triangular projections (small:s)

V. Number of lateral spines on P3 exp3

VI. Male TL less than 0.5 mm (y or n)

VII. Male CR longer than ansgt (y or n)

Character sequence:

I	II	III	IV	V	VI	VII	
y	s	s	p	2	y	n	*Oncaea borealis* (7.1.1)
y	l	e	p	?	n	?	*O. conifera* (7.1.2)
n	l	s	s	2	n	y	*O. englishi* (7.1.3)
n	s	s	#	2	y	y	*O. ivlevi* (7.1.4)
n	s	e	?	3	?	?	*O. prolata* (7.1.5)

KG 30 (*Corycaeus*)

Characters:

1. Number of setae on P4 enp

Character sequence:

1	
1	*Corycaeus catus* (4.1.2)
2	*C. anglicus* (4.1.1)

6.0 KG 5: ENTRY KEY TO THE CALANOIDA

Characters[1]:

I. Postero-lateral corners of Pro (PLC) rounded or angular, but without obvious projections or spines (round:rd), or extended as acute or blunt points, bearing true spines or occasionally enlarged as wing-like projections (extended:ex)

II. CR equal in length (eq) or unequal (un)

III. CR short (s: length of each ramus less than 0.5 x width of ansgt), 'normal' (n: length of each ramus approximately equal to width of ansgt), or long (l: length of each ramus greater than 1.5 x width of ansgt)

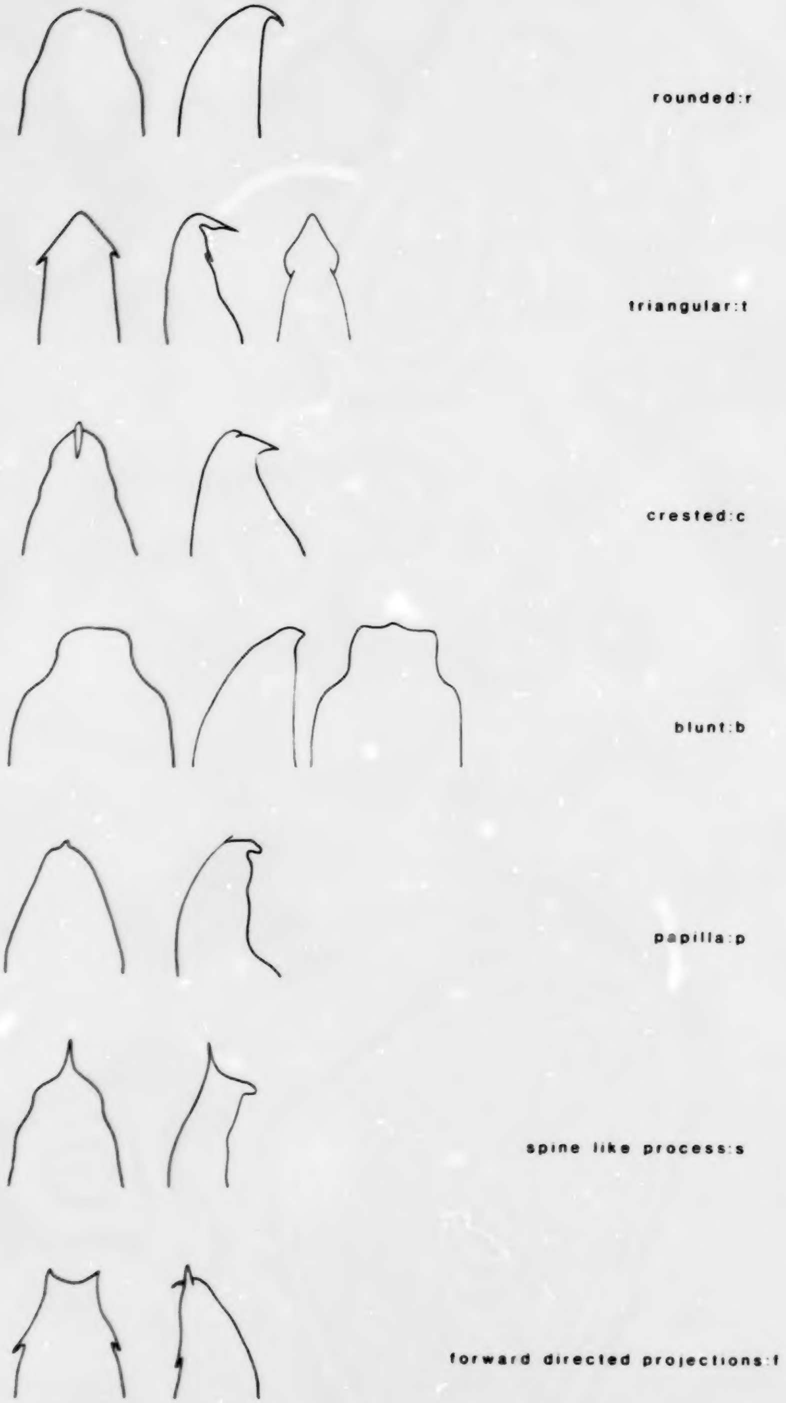
Character sequence:

I	II	III	KG
rd	un	n	100
rd	un	l	200
rd	eq	n	300
rd	eq	s	400
rd	eq	l	500
ex	un	l	600
ex	eq	n	700
ex	eq	s	800
ex	eq	l	900

---

[1] Characters used in the breakdown of KG's 100 - 900 are summarized in 6.1.

Fig.6


rounded:r
triangular:t
crested:c
blunt:b
papilla:p
spine like process:s
forward directed projections:f

Head shapes.

6.1 Characters used in the Breakdown of KG 5

Ur Urosome relative length

s: Shorter than 1/3 prosome length
r: Regular - approximately 1/3 prosome length
l: Longer than 1/3 prosome length

TL Total length

vs: Very small - less than 1.0 mm
s: Small - 1.0 to 2.5 mm
m: Medium - 2.5 to 4.0 mm
l: Large - 4.0 to 6.0 mm
vl: Very large - over 6.0 mm

Hd Head Shape (Fig. 6)

r: Head profile rounded, without projections in dorsal view
t: Head outline triangular with or without lateral hooks in dorsal view
c: Apex of head with acute process or true crest in dorsal view
b: Apex of head blunt (square-shaped) in dorsal view; may also be constricted posteriorly to form 'shoulders'
s: Apex of head in lateral view with acute, spine-like process
p: Apex of head in dorsal view with blunt papilla projecting anteriorly
f: Head profile with pair of lateral, forward-directed projections

AI Length of AI

l: Longer than total length by more than two antennal segments
r: 'Regular', approximately equal to total length
s: Short, usually reaching no farther than distal margin of gnsgt or Ur2

Ro Rostrum

y: Rostrum present
n: Rostrum absent

6.2 Keys to subgroups of Calanoida

Characters as in 6.1

KG 100

Character sequence:

Ur	TL	Hd	AI	Ro	KG	
s	+	r	l	y	1900	(Eucalanus)
s	+	t	l	y	1900	

KG 200

Character sequence:

Ur	TL	Hd	AI	Ro	KG	
l	m-l	p	l	y	3200	(Heterostylites)

KG 300

Character sequence:

Ur	TL	Hd	AI	Ro	KG	
s	vs	r	s	y		Microcalanus pygmaeus pusillus (12.2.1)
r	vs-l	r	r	y	1000	
r	+	r	l	y	1000	
s	vs-l	r	r	y	1000	
s	+	r	l	y	1000	
s	m-vl	t	l	y	1900	(Eucalanus)
s	vl	c	l	y	1040	(Neocalanus in part)
+	s-l	r	s	y	1200	
+	m-l	b	s	y	1210	(Scaphocalanus)
r	m-l	c	s	y	2000	
l	m-l	c	s	y	2000	
+	vs-l	r	+	n	2900	(Spinocalanus)
s	vs-s	b	s	+	3000	(Acartia)
r	vs-s	b	s	+	3000	
s	m	p	l	y		Haloptilus oxycephalus (2.4.2.1)
s	m	s	l	y		H. oxycephalus (2.4.2.1)
+	m-l	p	l	y	3300	(Heterorhabdus)
r	m	c	r	y	3920	(Gaetanus in part)
r	m-vl	r	s	y	5000	(Euchaeta)

Characters as in 6.1

KG 400

Character sequence:

Ur	TL	Hd	A1	Ro	KG	
r	l	r	s	y		*Undeuchaeta bispinosa* (14.8.1)
r	vl	r	s	y		*U. bispinosa* (14.8.1)
s	m-vl	r	s	+	1800	
s	m-vl	r	l	+	1800	
s	m-vl	c	s	+	1800	
s	m-vl	c	l	+	1800	
s	l-vl	r	r	y		*Onchocalanus magnus* (16.1.1)
t	vs-l	r	+	n	2900	(*Spinocalanus*)

KG 500

Character sequence:

Ur	TL	Hd	A1	Ro	KG	
l	vl	f	r	y		*Lucicutia bicornuta* (22.1.1)
l	s	r	l	y		*L. ovalis* (22.1.3)
l	s-m	p	r	y		*L. flavicornis* (22.1.2)
l	m-l	p	l	y	3300	(*Heterorhabdus*)*
l	m-vl	r	s	y	3400	(*Metridia*)
l	s	r	s	y	3500	(*Eurytemora*)

* The A1 of this genus frequently breaks; a confirming feature is the presence of a single seta on the right CR having twice the girth of the setae on the left CR.

Characters as in 6.1.

KG 600

Character sequence:

Ur	TL	Hd	Al	Ro	
l	s	y	s	n	*Tortanus discaudatus* (29.1.1)
l	s	y	r	n	*T. discaudatus*
l	s	b	l	y	*Centropages abdominalis* (21.1.1)
l	s	b	r	y	*C. abdominalis*
s	m-l	r	l	y	*Rhincalanus nasutus* (9.2.1)
s	m-l	t	l	y	*R. nasutus*

KG 700

Character sequence

Ur	TL	Hd	Al	Ro	KG	
+	s-l	r	s	y	1200	
s	l-vl	r	l	y		*Eucalanus hyalinus* (9.1.3)
l	m-l	p	l	y	3300	(*Heterorhabdus*)
r	l-vl	c	s	y	3600	
r	l	c	r	y	3600	
r	s-m	r	r	n	3700	
r	s-m	r	s	n	3800	(*Chiridius*)
r	s-l	r	r	y	3900	
r	m	s	r	y		*Gaetanus intermedius* (14.5.1)
+	+	s	l	y	3920	(*Gaetanus* in part)
+	l	s	r	y	3920	
r	vl	p	r	y		*Gaussia princeps* (20.3.1)
l	vl	p	r	y		*G. princeps*
s	m	t	s	y		*Epilabidocera longipedata* (27.1.1)
r	s-m	b	s	y	4000	(*Candacia*)
r	s-m	b	r	y	4000	
s	s-m	b	s	y	4000	
s	s-m	b	r	y	4000	

Characters as in 6.1

KG 800

Character sequence:

Ur	TL	Hd	Al	Ro	KG	
s	m	r	s	y	3900	(*Gaidius* in part)
s	vl	r	s	y		*Onchocalanus magnus* (16.1.1)
r	l	r	s	y		*Undeuchaeta bispinosa* (14.8.1)

KG 900

Character sequence:

Ur	TL	Hd	Al	Ro	KG	
l	m-l	p	l	y	3300	(*Heterorhabdus*)
l	s-vl	r	s	y	3400	(*Metridia*)
l	s	r	s	y	3500	(*Eurytemora*)
l	s	r	s	n		*Tortanus discaudatus* (29.1.1)
l	s	r	r	n		*T. discaudatus*
l	s	b	l	y		*Centropages abdominalis* (21.1.1)
l	s	b	r	y		*C. abdominalis*
s	m-l	r	l	y		*Rhincalanus nasutus* (9.2.1)
s	m-l	t	l	y		*R. nasutus*

6.3 Keys to Species of the Calanoida

KG 1000

Characters:

I. Segmentation of first two pairs of swimming legs (P1 exp-enp/P2 exp-enp)

II. Presence of a serrate edge on inner margin of fP5 bpl (y or n)

III. Number of Th segments

IV. A1 much longer than TL (long:l), or about equal to TL (regular:r)

V. Cephalosome elongate; conspicuous gap between mouth parts and swimming legs (y or n)

Character sequence:

I	II	III	IV	V	KG	
3-1/3-2	n	3	r	n	1010	
3-2/3-3	n	3	l	n		*Calocalanus styliremis* (10.1.1)
3-2/3-3	n	4	l	n		*Pachyptilus pacificus* (24.3.1)
3-2/3-3	n	3	r	n		*Paracalanus parvus* (11.1.1)
3-2/3-3	n	#	l	y	1900	(*Eucalanus*)
3-2/3-3	n	5	r	n	1030	(*Calanus*)
3-3/3-3	y	5	r	n	1040	(*Neocalanus*)
3-3/3-3	n	5	l	n		*Mesocalanus tenuicornis* (8.3.1)
2-2/3-2	n	4	l	n		*Rhincalanus nasutus* (9.2.1)

KG 1010

Characters:

I. Female P5 present on left side only (l); or both left and right P5 present (b); or absent (a)

II. P2-P4 with surface spination (y or n)

III. P3,4 exp3 with deeply indented outer edge (y or n)

Character Sequence:

I	II	III	KG	
b	y	n	1020	(*Scolecithricella*)*
l	n	y		*Ctenocalanus vanus* (12.4.1)
a	n	n		*Microcalanus pygmaeus pusillus* (12.2.1)

* See also KG 1200

KG 1020 (*Scolecithricella* in part)

Characters:

I. TL greater than 3.0 mm (y or n)

II. Number of outer edge spines on PI exp (2 or 3)

III. Number of segments in fP5 (2 or 3)*

IV. Right mP5 much shorter than lft mP5 (short:s) or rt and lft subequal (subequal:eq)

Character sequence:

I	II	III	IV	
n	2	2	eq	*Scolecithricella minor* (17.5.2)
n	3	2	s	*S. ovata* (17.5.3)
n	3	2	#	*S. subdentata* (17.5.4)
y	3	3	eq	*S. emarginata* (17.5.1)
n	3	3	eq	*Tharybis fultoni* (8.1.1)

* Right and left basipod of fP5 usually fused and indistinct from body; legs may appear to be composed of only one segment.

KG 1030 (*Calanus*)

Characters:

I. Range, Pro length of adult female (mm)[1]

II. Range, Pro length of adult male (mm)

III. Range, Pro length of fifth copepodite stage (CV)

IV. Shape of head in lateral view (rounded:r or angular:a)[2]

V. Female P5 enpl and rt mP5 enpl extend nearly to or beyond median distal corner of P5 expl (long:l), or never extend close to this corner (short:s)

VI. CV and CVI P5 bp2 each bearing an elongate, spiniform process on distal anterior margin (elongate:e), or process short and pointed or blunt (short:s)

Character sequence:

I	II	III	IV	V	VI	
2.5-3.3	2.6-3.1	2.3-2.8	m	s	s	*Calanus marshallae* (8.1.1)
2.0-2.7	1.9-2.4	1.9-2.3	a	l	e	*C. pacificus* s.l. (8.1.2)

[1] Body measurements are generally expressed as total length but in this case, the size separation is more distinct if prosome lengths (distance from apex of Hd to distal end of prosome) are used. Length is only an absolute method for separating species when there is a clear separation in sizes (e.g. KG 1040). With *C. marshallae* and *C. pacificus*, there is a slight overlap between the size ranges.

[2] Head profile shape is a very subjective characteristic which nevertheless becomes relatively obvious with experience.

KG 1040 (Neocalanus)

Characters:

I. TL of copepodite with 4 or 5 Ur segments greater than 6.5 mm (y or n)

II. TL of copepodite with 3 Ur segments greater than 4.5 mm (y or n)

Character sequence:

I	II	
y	y	Neocalanus cristatus (8.2.1)
n	n	N. plumchrus (8.2.2)

KG 1200

Characters:

- I. TL greater than 2.0 mm (y or n)
- II. Ro with two distinct terminal points (t) or single and undivided (s)
- III. Max2 with vermiform or knob-like sensory organs on distal lobes (y or n)
- IV. Pl expl with spine at outer distal corner (y or n)
- V. Female P5 absent (o), or if present bearing one (1) segment or number of segments (2, 3, 4, 5)
- VI. Male P5 uniramous (u) or biramous (b); and slender (s) or massive (m)

Character sequence:

I	II	III	IV	V	VI	KG	
n	t	y	n	1	b/s	1020	(*Scolecithricella*)**
y	s	y	n	2,3	#		*Racovitzanus antarcticus** (17.4.1)
y	t	y	n	2,3	b/m	1210	(*Scaphocalanus*)
n	t	n	y	3	u/s	1220	(*Clausocalanus*)
n	t	n	y	0	u/s		*Pseudocalanus* cf. *minutus* (12.1.1)
y	s	n	y	5	u/m		*Phyllopus integer* (25.2.1)
y	t	n	y	4	u/m	2010	(*Pleuromamma*)***
y	s	n	y	0	#		*Undeuchaeta bispinosa** (14.8.1)
y	t	n	y	0	b/s	3910	
y	s	n	y	0	b/s	3910	

* Male unknown.

** Male enp single reduced segment.

*** Head crest usually present, but may be reduced and difficult to see in some species.

KG 1210 (*Scaphocalanus*)

Characters:

I. TL greater than 3.5 mm (y or n)

II. A2 exp longer than enp (ex), enp longer (en) or the two subequal (eq)

III. Number of segments in fP5

IV. Hd of female cristate (c) or rounded (r)

V. Spine on outer distal margin of P2 expl extends to mid-point of P2 exp2 (y or n)

VI. Rami of lft mP5 subequal (y or n)*

Character sequence:

I	II	III	IV	V	
n	en	2	r	y	*Scaphocalanus brevicornis* (17.3.2)
n	en	2	r	n	*S. major* (17.3.5)
n	ex	2	r	y	*S. echinatus* (17.3.3)
n	eq	2	r	n	*S. subbrevicornis* (17.3.6)
y	en	3	c	n	*S. affinis* (17.3.1)
y	eq	2	c	n	*S. magnus* (17.3.4)
y	en	2	c	n	*S. magnus* (17.3.4)

* The lft mP5 lacks a bulbous swelling at the proximal portion of the bp2.

Note: Differences between species in this genus are often small and difficult to see. The genus is in need of revision.

KG 1220 (*Clausocalanus*)

Characters:

I. Female 3P5 longer than 2.0 x 1P5 (y or n)

II. In lateral view of female, gnsgt dorsal lobe arising from anterior edge of ventral lobe (dorsal:d), or, a portion of gnsgt ventral lobe visible anterior to the dorsal lobe (ventral:v)

III. Male Ur2 longer than 1.35 x 2P5 (y or n)

Character sequence:

I	II	III	
y	d	n	*Clausocalanus arcuicornis* (12.3.1)
n	v	y	*C. lividus* (12.3.2)
y	v	n	*C. parapergens* (12.3.3)

Note: The identifying characteristics used in KG 1320 are taken from Frost and Fleminger (1968).

The males of *C. arcuicornis* and *C. parapergens* can only be separated by looking at placement of the seminal vesicle within the prosome. If in lateral view the seminal vesicle extends anterior of the P1 attachment point to the prosome then it is *C. arcuicornis*. If the above is false then it could be *C. parapergens* or *C. lividus*. This distinction is difficult and not recommended by the authors.

KG 1800

Character:

I. Body densely spinose (y or n)

II. Segmentation of P1 exp-enp/P2 exp-enp

III. A2 exp longer than twice length of enp (y or n)

IV. P4 bpl with two or more spines above inner marginal seta (y or n)

V. Th4 fused with Th5 (f) or separate (s)

Character sequence:

I	II	III	IV	V	KG	
n	2-1/3-1	y	y	f	1810	(*Euchirella*)
n	2-1/3-1	n	y	s		*Pseudochirella polyspina* (14.9.1)
n	3-1/3-2	n	n	f		*Lophothrix frontalis* (17.2.1)
y	3-2/3-3	n	n	f		*Centraugaptilus porcellus* (24.1.1)

KG 1810 (*Euchirella*)

Characters:

I. Hd cristate (c) or rounded (r) in lateral view

II. Female gnsgt swollen on left side (l) or symmetrical (s) in dorsal view

III. Female P4 bpl with 5 or more spines above inner marginal seta (y or n)

IV. Right mP5 rami bent into elongate pincer or chela (y or n)

Character sequence:

I	II	III	IV	
c	l	n	#	*Euchirella pseudopulchra** (14.6.3)
c	l	#	y	*E. pulchra* (male)** (14.6.2)
r	l	n	#	*E. pulchra* (female) (14.6.2)
r	s	y	n	*E. rostrata* (14.6.4)
c	s	y	n	*E. curticauda* (14.6.1)

* Male unknown.

** Many specimens from the northeast Pacific have been referred to this species; however, Park (1976) described *E. pseudopulchra* as a new species from the area and felt that many of the earlier records of *E. pulchra* were in fact *E. pseudopulchra*.

KG 1900

Characters:

I. Number of outer spines on P1 exp3 (1 or 2)

II. Number of setae on md bp2 (1 or 3)

III. PLC with short, acute processes (y or n)

Character sequence:

I	II	III	
2	3	n	*Eucalanus bungii* (9.1.1)
2	1	n	*E. californicus* (9.1.2)
1	#	y	*E. hyalinus* (9.1.3)

KG 2000

Characters:

I. A2 with exp longer than enp (ex), enp longer (en) or the two subequal (eq)

II. Number of Th segments

III. PI expl with spine at outer distal corner (y or n)

IV. Female P5 present (p) or absent (a)

V. Max2 elongate, strongly built, raptorial (y or n)

Character sequence:

I	II	III	IV	V	KG	
eq	5	y	p	n	2010	(Pleuromamma)
eq	4	y	p	n	2010	
ex	3	n	p	n	1210*	(Scaphocalanus)
eq	3	y	a	n		Chirundina streetsi (14.7.1)
ex	3	y	p	y	5000	
ex	3	n	p	y	5000	

* See also KG 1200.

KG 2010 (*Pleuromamma*)

Characters:

I. TL of adult and CV larger than 2.5 mm (y or n)

II. Hd apex with a well-defined, sharp, forward directed process (y or n)

III. Number of denticles found on the proximal joints of AI

IV. Denticles large and all directed medially (all:a); or shorter, and not all directed medially (not:n)

V. Number of segments in uniramous fP5

VI. Male Ur symmetrical (s) or asymmetrical (a)

Character sequence:

I	II	III	IV	V	VI	
y	n	2	n	4	s	*Pleuromamma scutullata* (20.2.5)
y	n	4	a	4	#	*P. quadrungulata* (female) (20.2.3)
y	n	≥1	a	#	s	*P. quadrungulata* (male)
y	y	2	a	4	a	*P. xiphias* (20.2.6)
y	n	0	#	4	s	*P. robusta* (20.2.4)
y	n	2	a	4	#	*P. abdominalis* (female) (20.2.1)
y	n	0	#	#	a	*P. abdominalis* (male) (20.2.1)
n	n	0	#	3	s	*P. borealis* (20.2.3)

KG 2900 (Spinocalanus)

Characters:

I. Number of setae on outer edge of P2 enp2

II. Ventral surface of fPro spinulose (y or n)

III. PI exp3 armed with spines on posterior surface (y or n)

IV. Male P5 enp shorter than exp (y or n)

Character sequence:

I	II	III	IV	
1	n	n	n	Spinocalanus brevicaudatus (13.1.1)
1	y	y	y	S. horridus (13.1.2)
0	n	n	y	S. longicornis (13.1.3)

KG 3000 (*Acartia*)

Characters:

I. Ro absent (a) or present and composed of two thin filaments (f)

II. PLC armed with many spinules (m), or with only one distinct spinule on each side (s), or absent (a)

III. One or two fUr segments having stout spines on the dorsal margins (y or n)

Character sequence:

I	II	III	
a	a,m	n	*Acartia* cf. *clausi* (28.1.1)
a	s	y	*A. longiremis* (28.1.3)
f	s	y	*A. danae* (28.1.2)
f	a,m	n	*A. californiensis* (28.1.4)

NOTE: Bradford's (1976) partial review of *Acartia* subgenus *Acartiura* points out some of the problems with *Acartia clausi* from the northeastern Pacific. Within the study area there appear to be two or more species closely aligned to *A. clausi*. Until further work is done on the genus, this group should be referred to as *Acartia* cf. *clausi*.

KG 3200 (*Heterostylites*)

Characters:

I. TL (mm)

II. Number of segments by which AI exceeds distal end of Ur in adult (male/female)

III. Right mP5 exp2 with a spinose outer margin (many:m); or with 2 spines (two:t)

Character sequence:

I	II	III	
2.5-3.5	5-6/4	m	*Heterostylites longicornis* (23.2.1)
4.5-5.2	7-9/5-7	t	*H. major* (23.2.2)

NOTE: The validity of *H. major* as a distinct species is questionable. Tanaka (1964) quotes Sewell as doubting the validity of *H. major*, and further suggests that *H. major* may be a form of *H. longicornis*. Nevertheless, both forms have been recorded from western Canadian waters.

KG 3300 (Heterorhabdus in part)

Characters:

I. Hd apex armed with a short spine (y or n)

II. TL greater than 2.7 mm (y or n)

III. In lateral view, PLC of female extended ventrally as thin wing-like processes (y or n)

Character sequence:

I	II	III	KG	
n	n	n	3310	(Heterorhabdus)
n	y	n	3320	(Heterorhabdus)
y	y	y		*H. spinifrons* (23.1.5)

KG 3310 (*Heterorhabdus* in part)

Characters:

I. Female P5 expl armed distally with short spine on inner edge (y or n)

II. Right mP5 exp2 inner margin bearing a long process with a bifid tip (y or n)

III. Al equal to or shorter than TL (short:s); or exceeding TL (long:l)

Character sequence:

I	II	III	
y	y	n	*Heterorhabdus clausi* (23.1.1)
n	n	y	*H. papilliger* (23.1.2)

KG 3320 (Heterorhabdus in part)

Characters:

I. TL greater than 4.0 mm (y or n)

II. Female AI reaches ansgt (y or n)

III. Female P5 bp2 with seta (y or n)

IV. Number of segments in P5 enp

V. Masticatory edge of right (r) or left (l) mandible with large falciform denticle

Character sequence:

I	II	III	IV	V	
y	y	y	2	r	Heterorhabdus robustoides (23.1.3)
n	n	n	3	l	H. robustus (23.1.4)
n	y	n	3	#	H. tanneri (23.1.6)

KG 3400 (Metridia)

Characters:

I. Total adult body length (mm)

II. AI equal to or shorter than Pro (short:s); terminating near Ur4 (medium:m); or longer than TL (long:l)

Character sequence:

I	II	KG	
4.5-4.8	s		Metridia okhotensis (20.1.3)
2.5-3.6	m		M. curticauda (20.1.1)
7.0-8.5	l		M. princeps (20.1.3)
2.0-3.1	s	3410	(Metridia)

KG 3410

Characters:

I. Pro of fCVI longer than 2.00 mm (y or n)[1]

II. Male CVI ansgt wider than 0.13 mm (y or n)[1]

Character sequence:

I	II	
y	n	*Metridia pacifica* (20.1.4)
n	y	*M. lucens* s.l. (20.1.2)

[1] These measurements must be very precise as the separation between these two forms is slight. See Thorp (1980) for a complete discussion.

KG 3500 (Eurytemora)

Characters:

I. Female CR dorsal surface spinulose (s) or spinulations absent (a)

II. Male CR spinulose (s) or spinulations absent (a)

III. Apical spines of fP5 subequal (y or n)

IV. Inner process of fP5 expl denticulate (y or n)

V. Right m2P5 with proximal swelling (y or n)

Character sequence:

I	II	III	IV	V	
s	a	y	n	y	Eurytemora americana (19.1.2)
s	s	n	n	y	E. affinis (19.1.1)
a	a	n	y	n	E. pacifica (19.1.3)

KG 3600

Characters:

I. Number of Th segments

II. PLC extended: terminating in sharp points (p) or rounded (r)

III. Segmentation of P1 and P2 (exp-enp/exp-enp)

IV. Left mAl prehensile (y or n)

V. Mxp greatly enlarged and raptorial (y or n)

Character sequence:

I	II	III	IV	V	KG	
3	r	3-1/3-2	n	n		*Scottocalanus persecans* (17.1.1)
4	p	3-3/3-3	y	n		*Arietellus plumifer* (25.1.1)
3	#	3-1/3-1	n	y	5000	(*Euchaeta*)
3	#	2-1/3-1	n	y	5000	

KG 3700

Characters:

I. Pl expl with spine on outer distal corner (y or n)

II. Male Al asymmetrical (y or n)

Character sequence:

I	II	
y	y	Azygokeras columbiae (14.10.1)
n	n	Aetideus divergens male (see KG 3930) (14.1.1)

KG 3800 (*Chiridius*)

Characters:

I. TL of CV, CVI (mm)

II. PLC extend past mid-point of gnsgt in female (y or n)

III. P2 enp with two segments (may be poorly defined) in fCV, fCVI (2); or with only one segment (1)

Character sequence:

I	II	III	
>3.0	n	2	*Chiridius polaris** (14.3.2)
<3.0	y	1	*C. gracilis* (14.3.1)

* Male unknown.

KG 3900

Characters:

I. Number of P1 enp segments (1 or 2)

II. Distal lateral margin of P1 exp1 with stout spine (stout:s) or with one minute spine and one short fine seta (fine:f) or devoid of spinations (absent:a)

III. PLC projections blunt (b) or sharp (s)

IV. PLC projections extending well beyond mid-point of gnsgt (y or n)

Character sequence:

I	II	III	IV	KG	
2	a	s	#	3930	(*Aetideus*)
1	s	b	n		*Gaidius minutus* (14.4.1)
1	s	s	n		*G. variabilis* in part * (14.4.3)
1	f	s	y		*G. pungens* (male) (14.4.2)
1	?	s	y		*G. pungens* (female) (14.4.2)
1	a	s	#		*Gaetanus intermedius* in part** (14.5.1)

* See also KG 3910.

** See also KG 3920.

KG 3910

Characters:

I. Pl expl armed with short spine on distal lateral margin

II. Female PLC extend to mid-point of gnsgt (mid), or to distal edge of gnsgt (dis)

III. Ro with strongly divergent (st) or slightly divergent (sl) rami, or single and undivided (un)

IV. Female A2 exp longer than enp (ex), or the two subequal (eq)

Character sequence:

I	II	III	IV	
y	mid	sl	ex	Bradyidius similis (14.2.2)
y	dis	st	eq	B. saanichi (14.2.1)
n	mid	un	eq	Gaidius variabilis in part* (14.4.3)
y	mid	un	ex	Undeuchaeta bispinosa ** (14.8.1)

* See also KG 3900.

** Male unknown.

KG 3920

Characters:

I. TL of adult males greater than 4.0 mm (y or n)

II. In lateral view cephalic process of male reduced to crest (c) or large and robust (large:l) or small and slender, possibly absent (small:s)

III. TL of adult females greater than 4.8 mm (y or n)

IV. Ratio of fAI:TL

Character sequence:

I	II	III	IV	
y	c	y	1.5	*Gaetanus pileatus* (14.5.3)
n	l	n	2.0	*G. miles* (14.5.2)
n	s	n	0.7	*G. intermedius* in part* (14.5.1)

* See also 3900.

KG 3930 (*Aetideus*)

Characters:

I. TL greater than 2.0 mm (y or n)

II. PLC of female barely extend past (long:l), or do not reach (short:s), distal margin of gnsgt

III. PLC of female diverge slightly outward (o) or curve inward (i) in dorsal view

Character sequence:

I	II	III	
y	s	i	*Aetideus pacificus** (14.1.2)
n	l	o	*A. divergens* (14.1.1)

* Male unknown.

KG 4000

Characters:

I. TL greater than 5.0 mm (very large:vl), between 3.0 and 5.0 mm (large:l) or less than 3.0 mm (small:s)

II. In dorsal view, Hd rounded (r), blunt (b), or papillate (p)

III. Number of acute lateral processes on gnsgt (0, 1, 2)

IV. Gnsgt process acutely bent (y or n)

V. PLC smoothly rounded (r), angular (a), or terminating in sharp points (p)

Character sequence:

I	II	III	IV	V	KG	
+	p	0	#	r	3300	(*Heterorhabdus*)
vl	r	0	#	a		*Onchocalanus magnus* (16.1.1)
l	b	0	#	p		*Candacia columbiae* (female) (26.1.2)
!	b	1	y	p		*C. columbiae* (male) (26.1.2)
s	b	2	#	p		*C. bipinnata* (female) (26.1.1)
s	b	1	n	p		*C. bipinnata* (male) (26.1.1)

KG 5000 (Euchaeta)

Characters:

I. TL exceeding 5.0 mm (y or n)

II. In dorsal view, PLC broadly rounded (r) or elongate (e)

III. In dorsal view, female gnsgt symmetrical (sy); or asymmetrical (as)

IV. In ventral view, female gnsgt symmetrical (sy); or asymmetrical with lamella on left side of genital field (as)

V. Naked seta arising at inner distal corner of CR straight (s); or curved twice (c)

Character sequence:

I	II	III	IV	V	
y	r	sy	sy	s	Euchaeta spinosa (15.1.4)
n	r	as	as	s	E. media (15.1.3)
y	e	sy	sy	c	E. elongata (15.1.2)
y	r	sy	sy	c	E. californica* (15.1.1)

* Male unknown.

7.0 SPECIES DESCRIPTIONS

7.1 HARPACTICOIDA

1.1 Microsetella Brady and Robertson, 1873

Morphology:

Body fusiform and slightly laterally compressed; Pro cylindrical, not much broader than Ur; Ro short, stout, curved; CR short; A1 very short, six-segmented (1, 2).

FEMALE Ur four-segmented.

MALE Ur five-segmented, occasionally six; A1 slightly geniculate.

Segmentation of Ur may be indistinct; separation of sexes will require dissection and examination of P5.

References:

1) Davis, 1949b
2) Wilson, 1932

1.1.1 Microsetella norvegica (Boeck, 1864)

Synonymy:

Setella norvegica: Boeck (1864)
Microsetella atlanticum: Brady and Robertson (1873)
Ectinosoma atlanticum: Brady (1883)
Microsetella atlantica: Giesbrecht (1892)

Morphology:

Pro elongate, fusiform, tapering at either end; separation between Pro and Ur indistinct; each CR with one elongate seta about equal in length to TL, one shorter seta about equal in length to the Ur, and two very small setae (1).

FEMALE TL 0.35-0.57 mm; P5 with three lobes, the innermost of which bears two setae, one of which is about twice the length of the other; Ur four-segmented (1).

MALE TL 0.33-0.51 mm; A1 geniculate, Ur five-segmented (1).

Distribution and Occurrence:

Reported from all oceans, from the Antarctic to the Arctic, including the Red, Mediterranean, Adriatic, Baltic and North Seas (1). Locally, reported from the vicinity of the Strait of Juan de Fuca (1) and the Queen Charolotte Islands (2).

Life History:

Juveniles undescribed; key valid for adults only.

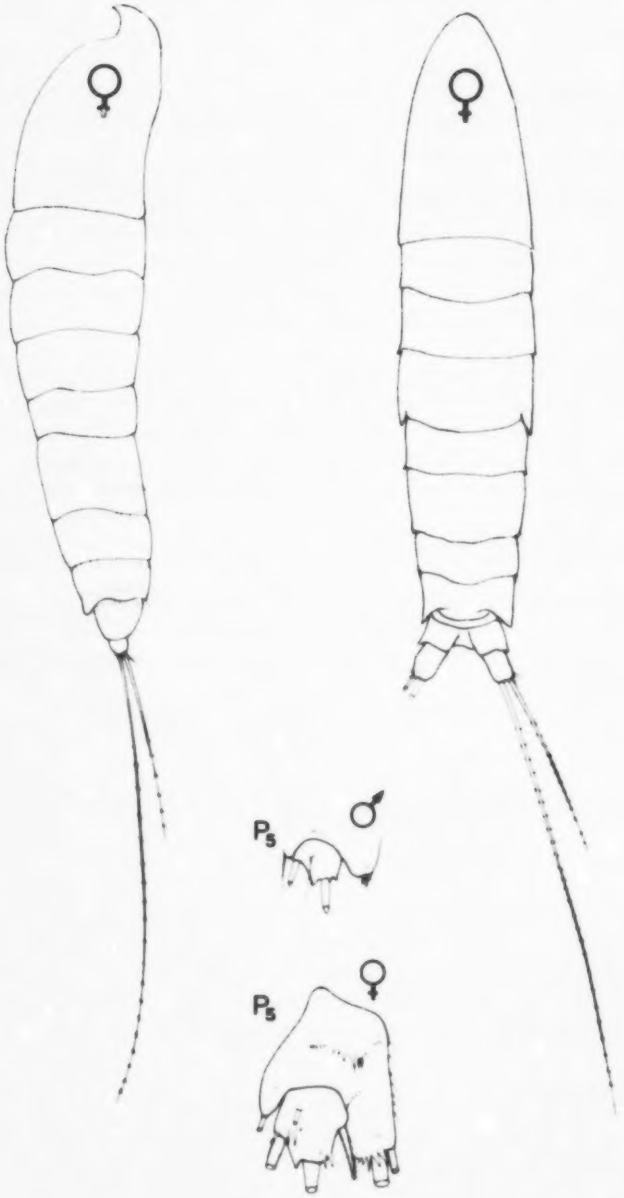
Comments:

Other harpacticoids may be found in the plankton, particularly benthic forms which may occasionally rise into the water column as a swarm. Here, we describe one species, Microsetella norvegica, which is rare but planktonic, and occasionally occurs in the plankton of the study area. For positive identification of this or any other species of harpacticoid, refer to Wells (3).

References:

1) Davis, 1949b
2) Cameron, 1957
3) Wells, 1976

1.1.1



Microsetella norvegica

from Shen and Bai,1956; Owre and Foyo,1967; Tschislenko,1967

1.1.2 Microsetella rosea (Dana, 1852)

Morphology:

Pro elongate, fusiform, tapering at either end; separation between Pro and Ur indistinct; each CR with one elongate seta about 1.7 x TL and one shorter, plumose seta (1, 2).

FEMALE TL 0.57-0.90 mm; CR each bear a short terminal seta in addition to the normal armature of two setae; P5 with three lobes, outer lobe bearing a single short spine, middle lobe with two elongate, subequal setae and one shorter seta, and inner lobe with two elongate, subequal setae (1).

MALE TL 0.6-0.7 mm; gnsgt divided, spermatophores conspicuous and showing through the body of ripe males; A1 six-segmented; P5 with three lobes, outer lobe bearing a single heavy spine, middle lobe with two coarsely setose setae, one about ½ the length of the other, and inner lobe with three short subequal spines (2).

Distribution and Occurrence:

Reported from the Malay Archipelago, Indian Ocean, Red, Mediterranean and Adriatic Seas, Atlantic Ocean, Indo-Pacific and North Pacific Ocean (1). Locally, reported from the Vancouver Island region and the Strait of Georgia (1, 3).

Life History:

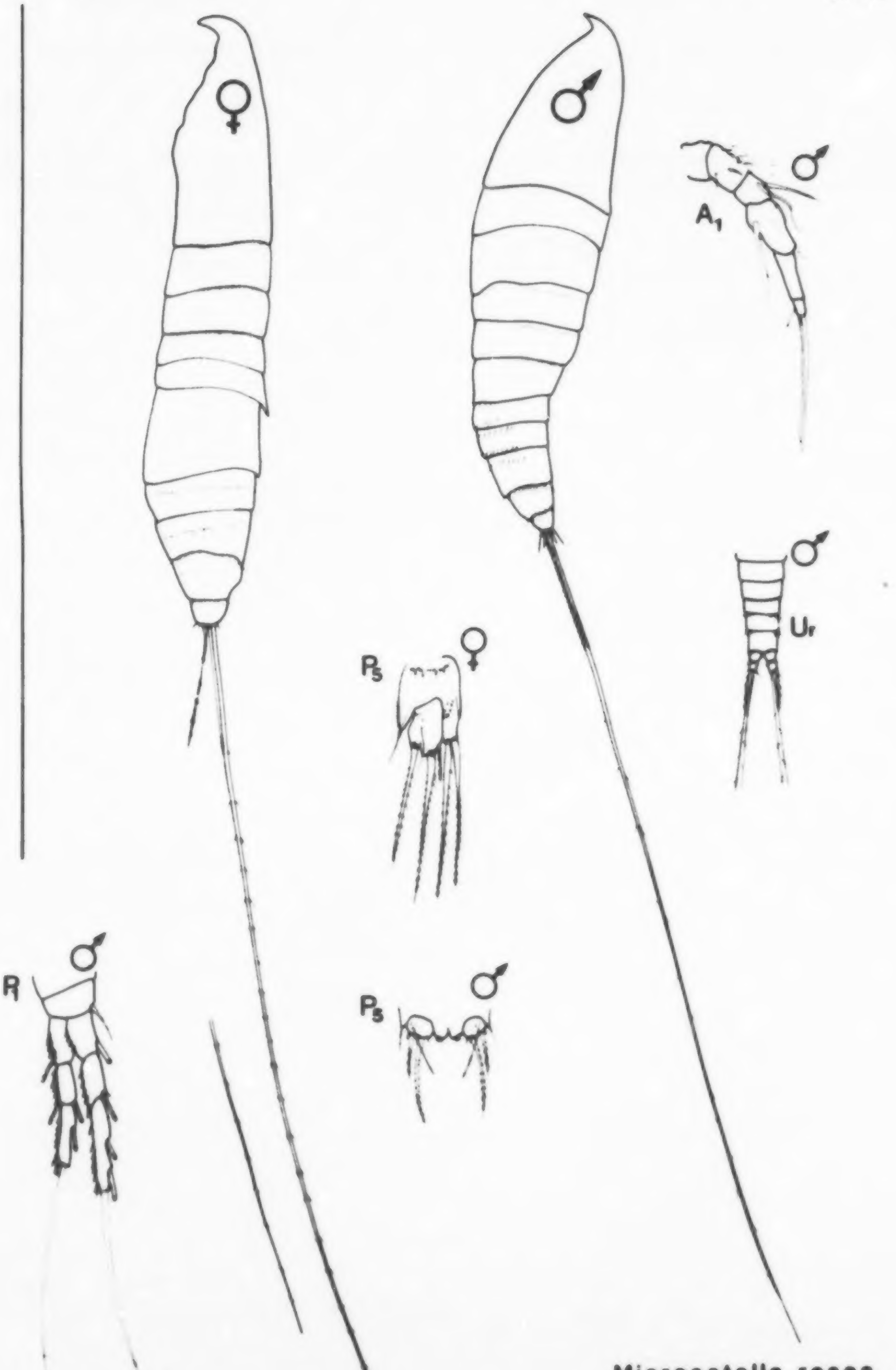
Juveniles undescribed; key valid for adults only.

Comments:

Other harpacticoids may be found in the plankton, particularly benthic forms which may occasionally rise into the water column as a swarm. Microsetella rosea is rare but planktonic, and occasionally occurs in plankton samples within the study area. For positive identification of this or any other species of harpacticoid refer to Wells (4).

References:

1) Davis, 1949b
2) Johnson, 1942
3) Fulton, 1972
4) Wells, 1976


♀
♂
A1 ♂
Ur ♂
P5 ♀
P1 ♂
P5 ♂

Microsetella rosea

from Johnson, 1942; Lang, 1948

7.2 MONSTRILLOIDA

2.1 Monstrilla Dana, 1848

Morphology:

Pro slender, elongate; ansgt reduced, PI-P4 bp massive, enp and exp comparatively short. Characterized by an elongate cephalosome and the absence of any feeding appendages (1).

FEMALE Gnsgt bearing ventrally two spiniform processes (1).

MALE Gnsgt bearing ventrally a stout terminally bilobed process; AI geniculate between 4 AI and 5AI (1).

References:

1) Sars, 1921

2.1.1 Monstrilla canadensis McMurrich, 1917

Morphology:

FEMALE Undescribed.

MALE TL 1.5 mm; cephalosome widening posteriorly in dorsal view; Ur four-segmented, gnsgt prolonged ventrally into a strong, cylindrical projection broadened distally into two lobe-like processes; A1 five-segmented, geniculation prominent; 5A1 narrow at base but broadening distally into a hood-like process marked on the outer surface by a series of curved lines of minute spines (1).

Distribution and Occurrence:

Reported from the northwestern Atlantic Ocean from the type locality (Passamaquoddy Bay) (1), from Ungava Bay (2), from the North Pacific Ocean near Kodiak Island (3), and locally from Departure Bay (4).

Life History:

Only the adult and NI appear in the plankton; other juvenile stages are endoparasitic in molluscs and polychaetes and their ecology is poorly under stood.

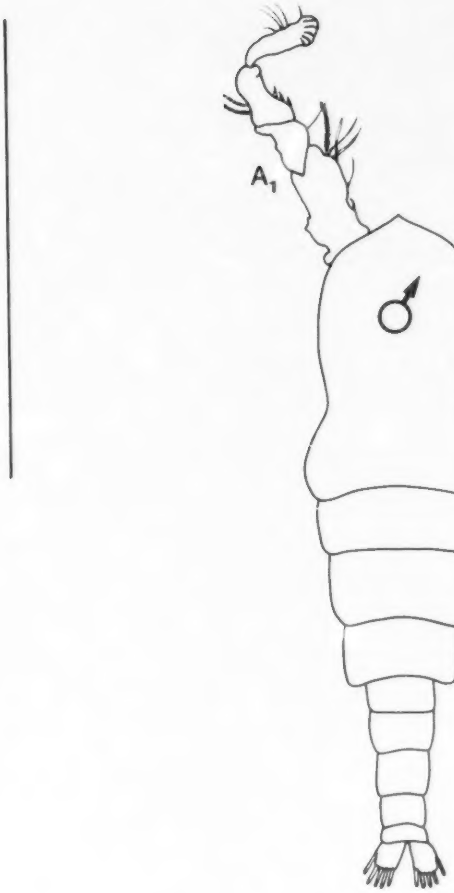
Comments:

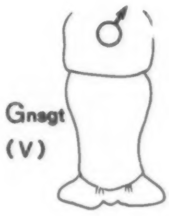
M. canadensis, for which only the male is known, may be the male of M. helgolandica (2). The taxonomy of the family is in need of further study.

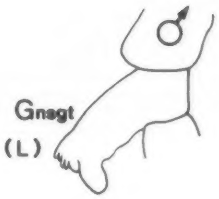
References:

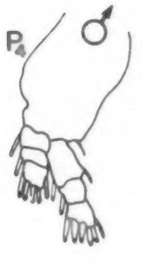
1) McMurrich, 1917
2) Fontaine, 1955
3) Threlkeld, 1977
4) Fulton, pers. comm.

2.1.1









Monstrilla canadensis

from McMurrich, 1917

2.1.2 Monstrilla helgolandica Claus, 1863

Synonomy:

M. serricornis: Sars (1921), Rose (1933)

Morphology:

Pro robust, broadening posteriorly; two eyes visible immediately dorsal to the A1 origin; A1 less than ½ length of cephalosome, A1 setae all single, unbranched (1).

FEMALE TL 1.4-2.3 mm; Ur four-segmented; gnsgt long, with two ventral spiniform processes extending past CR; P5 slender, strongly divergent, each with two setae (1).

MALE TL 1.1 mm; Ur five-segmented; gnsgt with ventral bilobed processes fringed with spines; P5 absent, A1 five-segmented, terminal segment with three rows of minute subapical spines (2).

Distribution and Occurrence:

Reported from the eastern North Atlantic Ocean and Mediterranean Sea, Ungava Bay, the Malay Archipelago, and the Indian Ocean (1, 2). Locally, reported from the Strait of Georgia (1).

Life History:

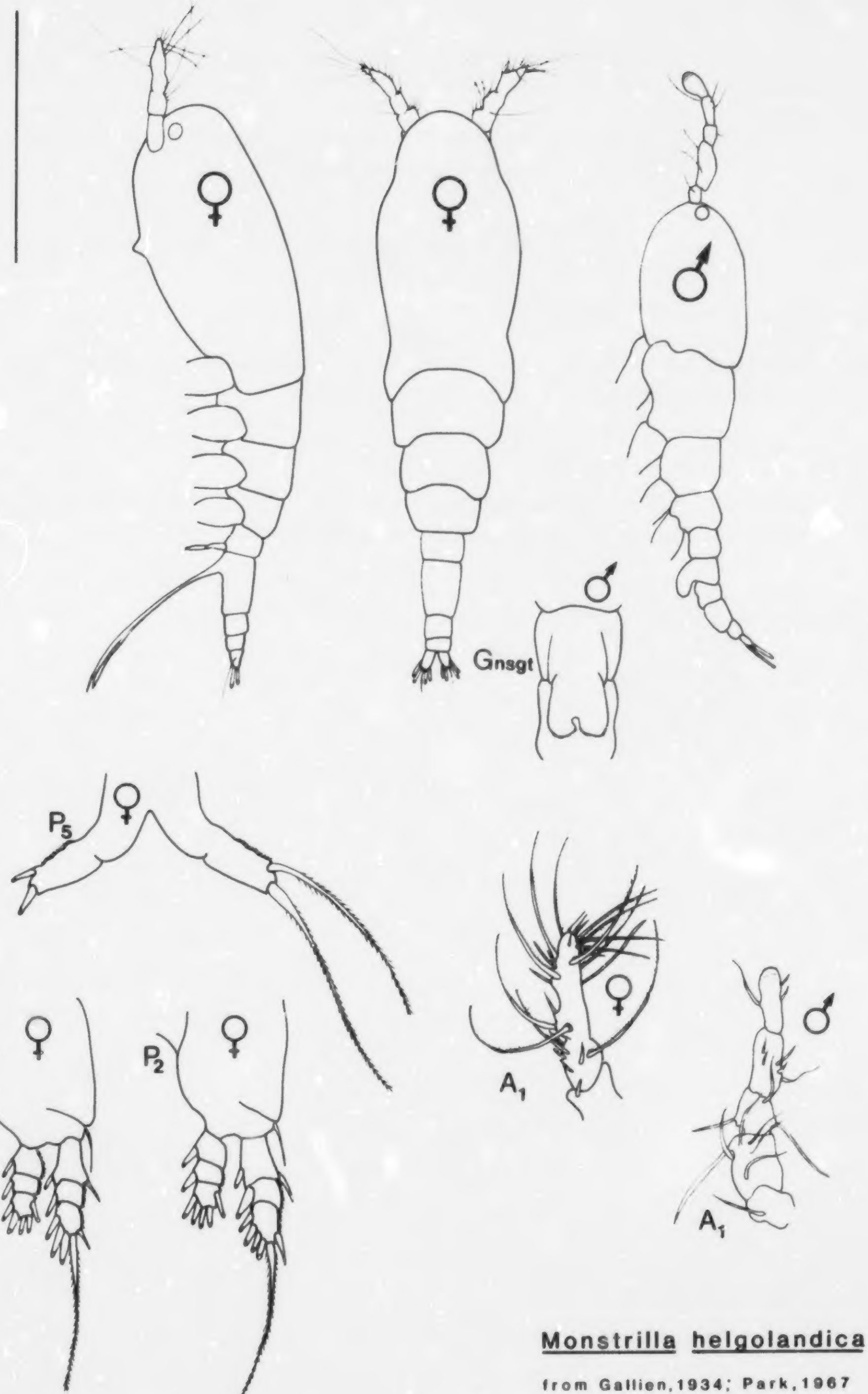
Only the adult and NI appear in the plankton, other juvenile stages are endoparasitic in mollusks and polychaetes and their ecology is poorly understood. In the northeastern Atlantic, juveniles are parastic on the gastropod Odostomia rissoides. The host for the parasite stages of M. helgolandica in the northeastern Pacific is unknown.

Comments:

Gallien's (2) description of the female differs from Park's (1) in the segmentation of the A1. Park's specimen has only two distinct segments and Gallien's has four distinct segments. M. canadensis is often speculated to be the male of M. helgolandica (3, 4) and further investigation is needed to clarify this point.

References:

1) Park, 1967a
2) Gallien, 1934
3) Threlkeld, 1977
4) McMurrich, 1917


♀
♀
♂
♂
Gnsgt
P5 ♀
P1 ♀
P2 ♀
A1 ♀
♂ A1

Monstrilla helgolandica

from Gallien,1934; Park,1967

2.1.3 Monstrilla longiremis Giesbrecht, 1892

Morphology:

Pro elongate, cephalosome over ½ of TL, rectangular; A1 as long as cephalosome; A1 terminal setae branching (1).

FEMALE TL 3.7 mm; gnsgt with two ventral spiniform processes extending past CR; P5 each with four setae (1).

MALE TL 2.0 mm; gnsgt with two short ventral projections each terminating in a short spine. P5 each with one seta (1, 2).

Distribution and Occurrence:

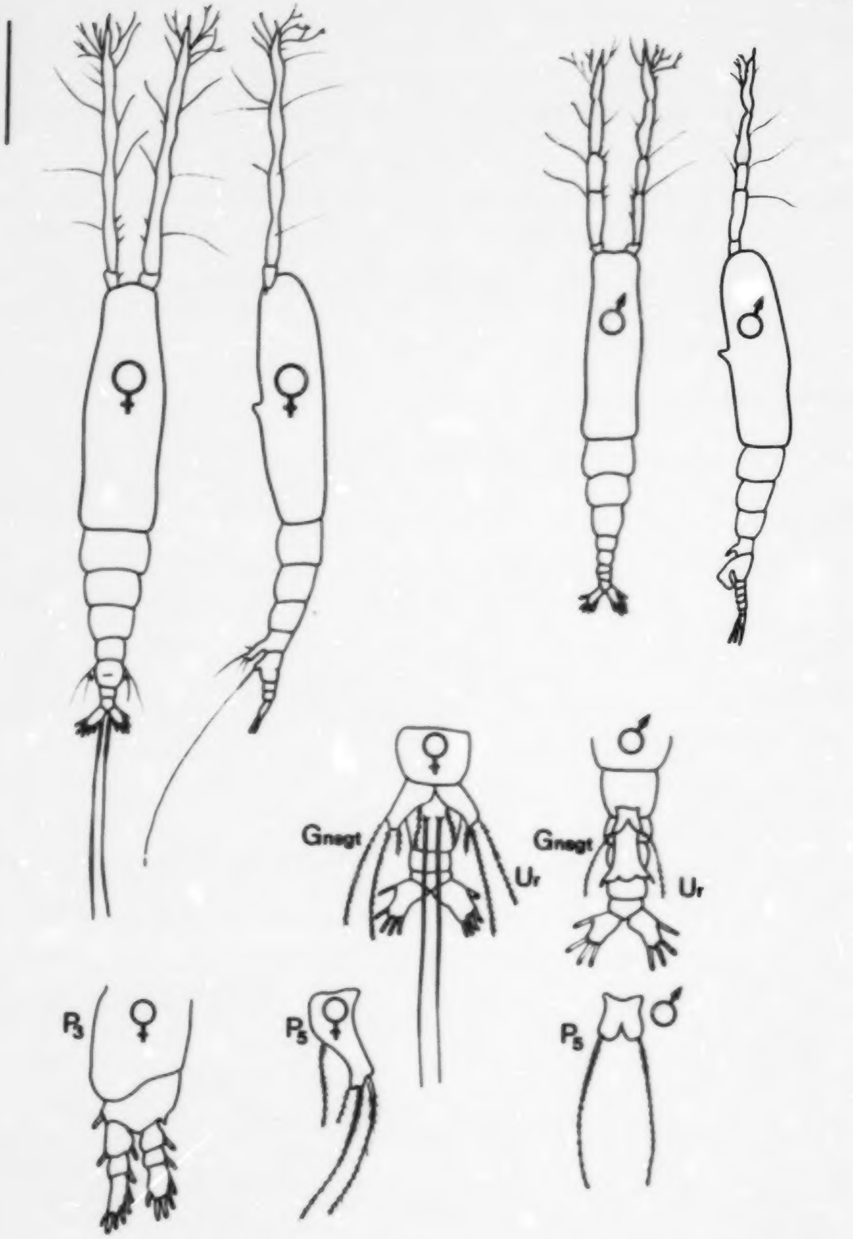
Reported from the eastern North Pacific Ocean and Mediterranean Sea (1). Locally, reported from Alice Arm, B.C. (3).

Life History:

Only the adult and NI appear in the plankton; other juvenile stages are endoparasitic in mollusks and polychaetes and their ecology is poorly understood.

References:

1) Rose, 1933
2) Sars, 1921
3) Fulton, pers. comm.


♀
♀
♂
♂
♀
♂
Gnsgt
Ur
Gnsgt
Ur
P3
♀
P5
♀
P5
♂

Monstrilla longiremis

from Rose, 1933

2.1.4 Monstrilla spinosa Park, 1967

Morphology:

Cephalosome at least ½ TL; Ro prominent; Thl, 2 each with two conspicuous spines arising from distal dorsal margin; the four subterminal setae of the A1 are dichotomously branched (1).

FEMALE TL 2.87 mm; gnsgt bearing two ventral spiniform processes which extend beyond the CR. A1 longer than cephalosome (1).

MALE TL 1.50 mm; gnsgt bears ventrally a prominent genital protuberance which carries distally a pair of spiniform processes. A1 just shorter than cephalosome (1).

Distribution and Occurrence:

Reported only from the type locality, the Strait of Georgia (1).

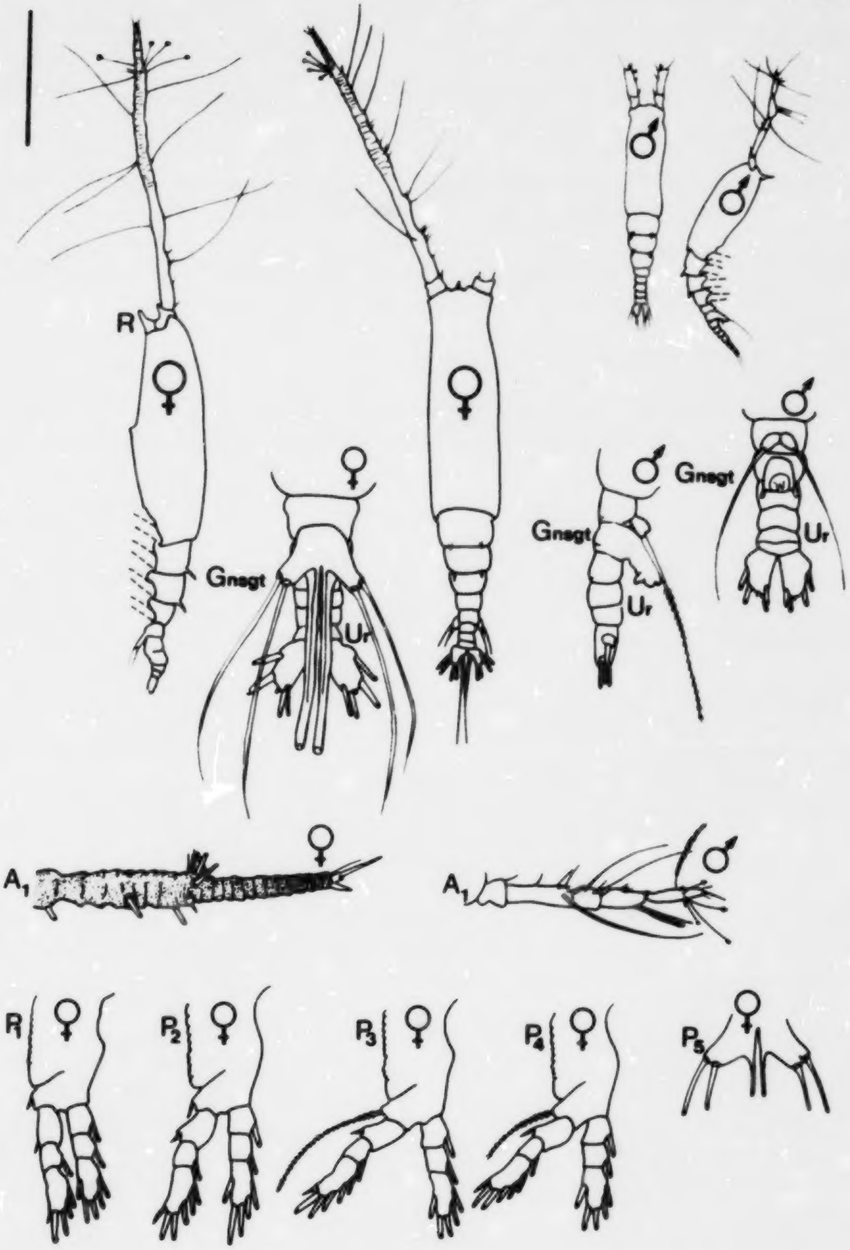
Life History:

Only the adult and NI appear in the plankton; other juvenile stages are endoparasitic in mollusks and polychaetes and their ecology is poorly understood.

References:

1) Park, 1967a

2.1.4


R
♀
Gnsgt
♀
Ur
♀
♂
♂
♂
Gnsgt
Ur
♂
Gnsgt
Ur
A_1
♀
A_1
♂
P_1
♀
P_2
♀
P_3
♀
P_4
♀
P_5
♀

Monstrilla spinosa

from Park,1967

2.1.5 Monstrilla wandelii Stephensen, 1913

Morphology:

Cephalosome exceeds ½ TL; Pro narrowed posteriorly; A1 shorter than cephalosome, with no branched setae (1).

FEMALE TL 1.98-2.46 mm; gnsgt with two ventral spiniform processes which extend almost to the end of the CR (1).

MALE TL 1.63 mm; gnsgt with a prominent, unbranched ventral protuberance (1).

Distribution and Occurrence:

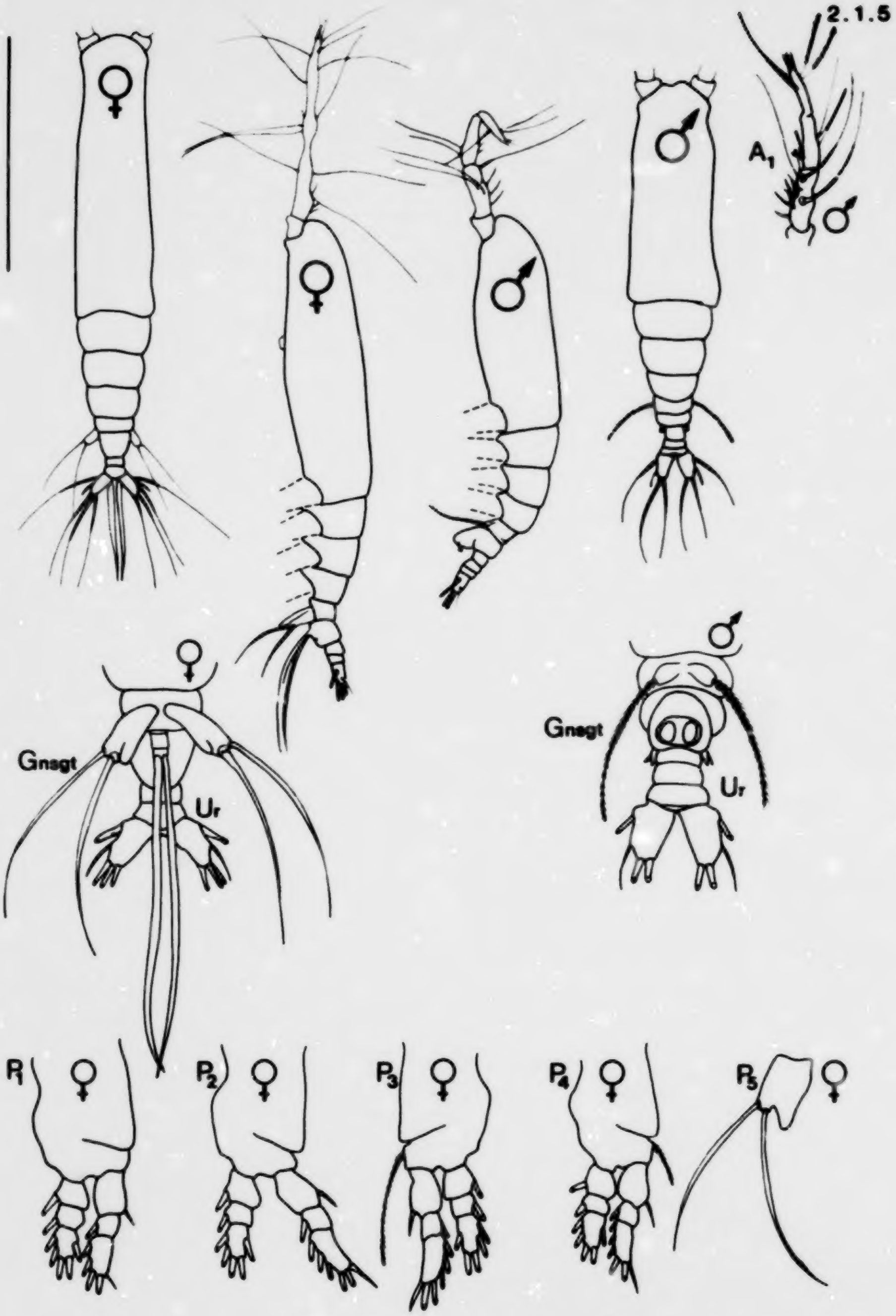
Reported from the northwestern Atlantic Ocean near West Greenland (type locality) (1), and from the North Pacific near Kodiak Island (2). Locally, reported from the Strait of Georgia (1).

Life History:

Only the adult and NI appear in the plankton; other juvenile stages are endoparasitic in mollusks and polychaetes and their ecology is poorly understood.

References:

1) Park, 1967a
2) Threlkeld, 1977


♀
♀
♂
♂
2.1.5
A1
♂
♀
Gnsgt
Ur
♂
Gnsgt
Ur
P1 ♀
P2 ♀
P3 ♀
P4 ♀
P5 ♀

Monstrilla wandelii

from Park, 1967

7.3 CYCLOPOIDA

3.1 Ascomyzon Thorell, 1859

Synonymy:

Asterocheres Boeck
Cyclopicera Brady (part)
Artotrogus Brady (part)

Morphology:

Pro almost as broad as long, dorsoventrally compressed (1).

FEMALE gnsgt broad, with lateral fringe of hairs (1).

MALE gnsgt enlarged, broader than that of female, and armed at each distal corner with a triangular lobe carrying a short spine (1).

References:

1) Sars, 1913

3.1.1 Ascomyzon rubrum Campbell, 1929

Morphology:

A1 short, nineteen-segmented; A2 robust with a strong apical spine; Pro almost as wide as long; Ur short (1).

FEMALE TL 0.95-1.1 mm; Ur three-segmented (1).

MALE Undescribed.

Distribution and Occurrence:

Known only from the northeastern Pacific Ocean. Originally described from Departure Bay, Vancouver Island. Also reported from the Strait of Georgia (2).

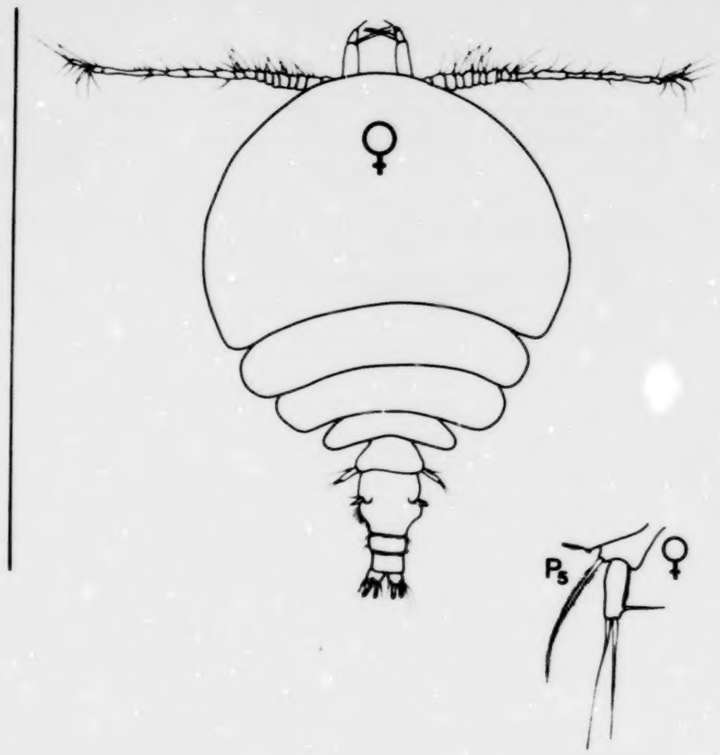
Life History:

Juveniles undescribed; however, at least the CV may be separable based on the wide Pro and short Ur.

References:

1) Campbell, 1929b
2) Legare, 1957

3.1.1



Ascomyzon **rubrum**

from Campbell, 1929

4.1 Corycaeus Dana, 1849

Morphology:

Pro cylindrical; PLC acute; Hd with two large, cuticular lenses, Ur one- or two-segmented; CR elongate; A1 short, six-segmented; P5 reduced to small setae (1).

FEMALE Mxp curved terminal spine less than half the length of 2A2 (1).

MALE Mxp curved terminal spine equal in length to 2A2(1).

References:

1) Davis, 1949b

4.1.1 Corycaeus anglicus Lubbock, 1857

Synonymy:

Corycaeus affinis: McMurrich (1916); Campbell (1929b); Davis (1949); Cameron (1957); Legare (1957); Fulton (1968; 1972)
C. japonicus: Mori (1937)

Morphology:

PLC acute, extend caudally; Ur with three segments; gnsgt with median ventral hook near proximal margin; P4 enp reduced, with one or two segments and two apical setae (1).

FEMALE TL 1.1 mm; two distinct Th segments; cuticular lenses small (1).

MALE TL 0.8-0.9 mm; three distinct Th segments; cuticular lenses large (1).

Separable from the similar C. catus by the presence of two apical setae on the P4 enp (cf. 1 seta for C. catus).

Distribution and Occurrence:

Northeastern Atlantic Ocean (coast of Europe) (2) and Sea of Japan (3). Locally, reported from the coast of Vancouver Island (1), the Strait of Georgia (4, 5), and the vicinity of the Queen Charlotte Islands (6).

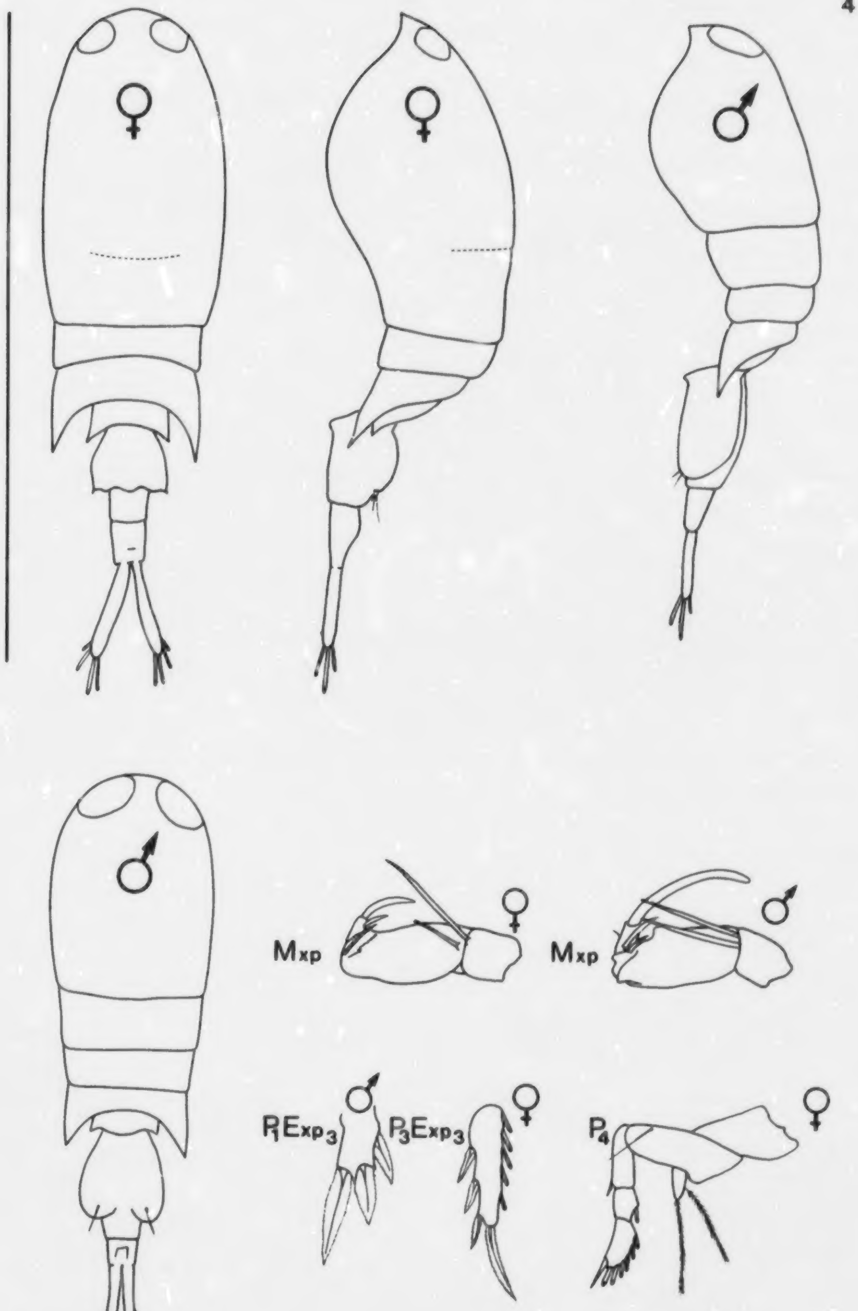
Life History:

Juveniles undescribed; however, the CV should be separable by the presence of two apical setae on the P4 enp.

References:

1) Davis, 1949b
2) Rose, 1933
3) Mori, 1937
4) Campbell, 1929b
5) Legare, 1957
6) Cameron, 1957

4.1.1


♀
♀
♂
♂
Mxp
♀
Mxp
♂
P_1Exp_3
♂
P_3Exp_3
♀
P_4
♀

Corycaeus anglicus

from Rose, 1933

4.1.2 Corycaeus catus Dahl, 1894

Synonymy:

Corycaeus obtusus: Giesbrecht (1892:part); Herdman et al. (1898)

Morphology:

PLC acute, extended caudally; Ur with three segments; P4 enp reduced, one-segmented, but bearing a single, long seta (1).

FEMALE TL 1.2 mm; Hd rounded; gnsgt elongate, tapering posteriorly (1).

MALE TL 0.9 mm; Hd appears truncated anteriorly in dorsal view; gnsgt large, armed proximally with a hook-like projection on ventral side (1).

Separable from the similar C. anglicus by the presence of one apical seta on the P4 enp (cf. 2 setae for C. anglicus).

Distribution and Occurrence:

Reported from the Pacific and Atlantic Oceans (1). Locally, reported as common near Port Townsend, Washington (2).

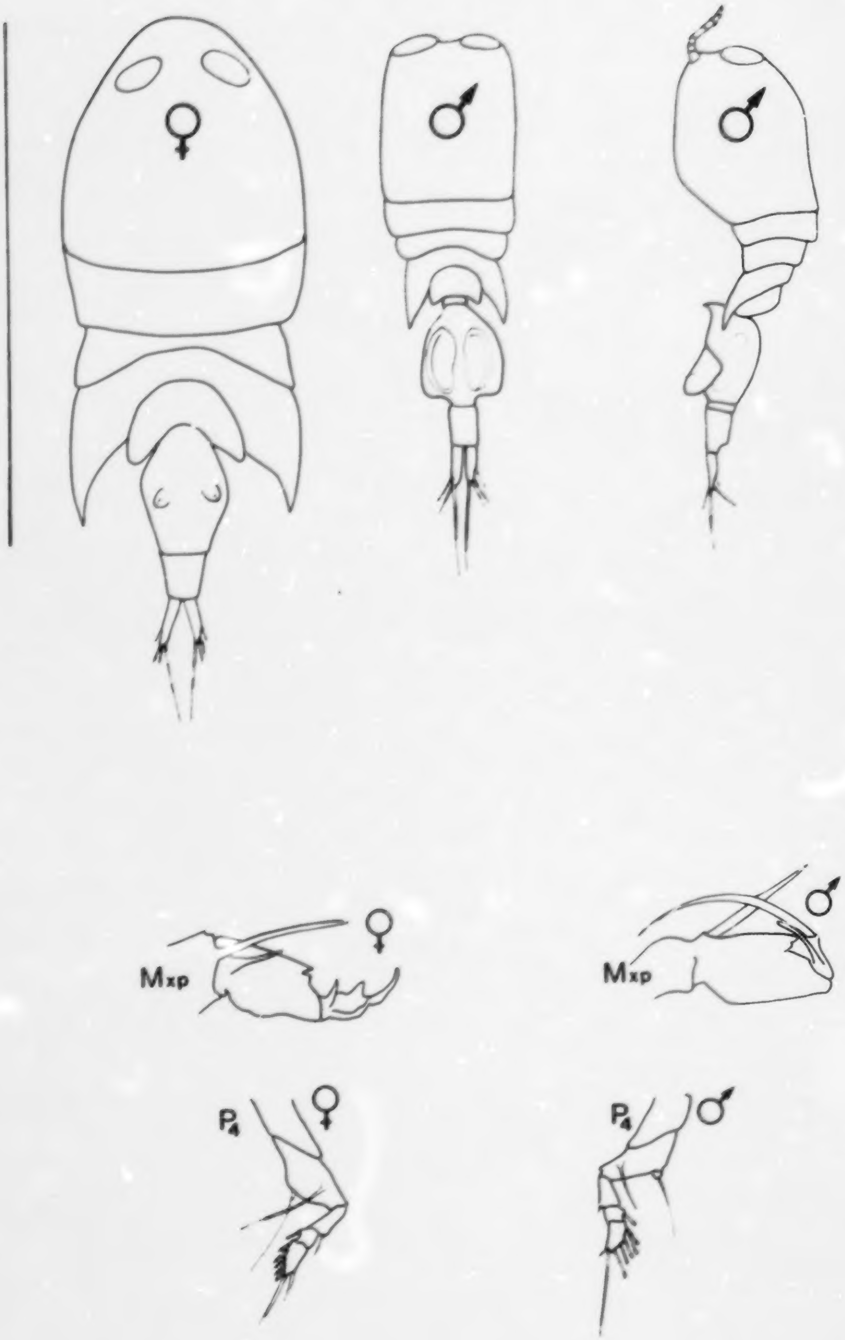
Life History:

Juveniles undescribed; however, the CV should be separable by the single seta on the P4 enp.

References:

1) Mori, 1937
2) Herdman et al., 1898

4.1.2


♀
♂
♂
Mxp
♀
Mxp
♂
P4
♀
P4
♂

Corycaeus catus

from Mori, 1937

5.1 Macrocheiron Brady, 1872

Morphology:

Pro elongate; Ur elongate; Ro with a slender, needle-like process; A1 short. P1-P3 with three-segmented rami, P4 segmentation 3-1 or 3-2; P5 one-segmented with two terminal setae (1).

FEMALE Ur five-segmented; A1 seven-segmented (1).

MALE Ur six-segmented (1).

References:

1) Humes and Stock, 1973

5.1.1 Macrocheiron sargassi Sars, 1916

Morphology:

Pro, Ur elongate; A1 short; gnsgt large; P4 segmentation: 3-1 or 3-2 (1, 2).

FEMALE TL 0.8-1.2 mm; Ur five-segmented (1, 2).

MALE TL 0.6-1.0 mm; Ur six-segmented (1, 2).

Distribution and Occurrence:

Reported from the northwestern Atlantic Ocean (Sargasso Sea) and from the Caribbean Sea near the island of Curacao (2). Locally, reported from Departure Bay (1). Typically associated with ascidians, although other members of the genus are free swimming (2).

Life History:

Juveniles undescribed, key valid for adults only.

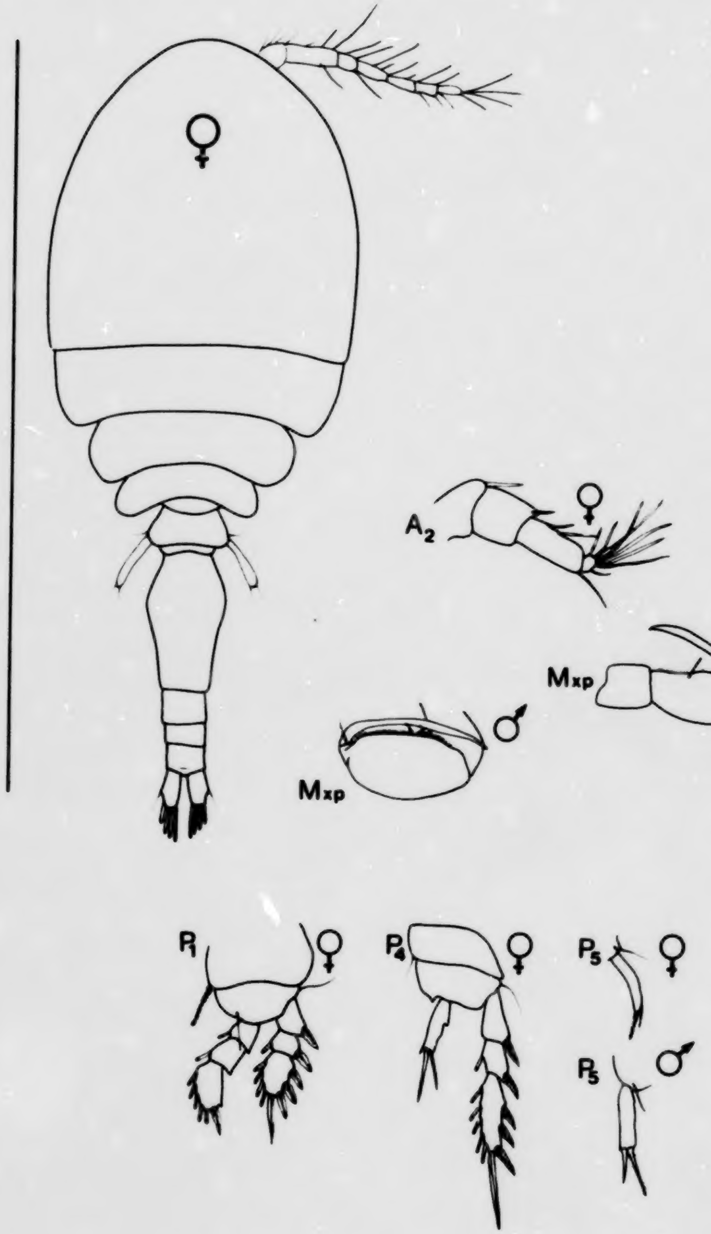
Comments:

The only species of the genus Macrocheiron reported from the study area. The Departure Bay record (1) is poorly documented and unverified (2).

References:

1) Campbell, 1930
2) Humes and Stock, 1973

5.1.1


♀
A2
♀
Mxp
♀
Mxp
♂
P1
♀
P4
♀
P5
♀
P5
♂

Macrocheiron sargassi

from Sars, 1916; Humes and Stock, 1973

6.1 Oithona Baird, 1843

Morphology:

Pro slender; Ur elongate; A1 elongate with ten to fifteen segments; P1-P4 segmentation all 3-3; P5 rudimentary (1).

FEMALE Ur five-segmented (1).

MALE Ur six-segmented; both A1 geniculate (1).

References:

1) Davis, 1949b

6.1.1 Oithona similis Claus, 1863

Synonymy:

Oithona helgolandica: Sars (1916)
O. challengeri: Brady (1883)

Morphology:

Pro elongate; Pro:Ur ratio approximately 1.3; A1 just longer than Pro; Ro present in female only, acute, ventrally directed (1).

FEMALE TL 0.7-1.0 mm (1).

MALE TL 0.5-0.7 mm (1).

Distribution and Occurrence:

Worldwide in all oceans (1). Locally, reported as common in deep waters in and adjacent to the Strait of Georgia (2, 3, 4), and from the vicinity of the Queen Charlotte Islands (5).

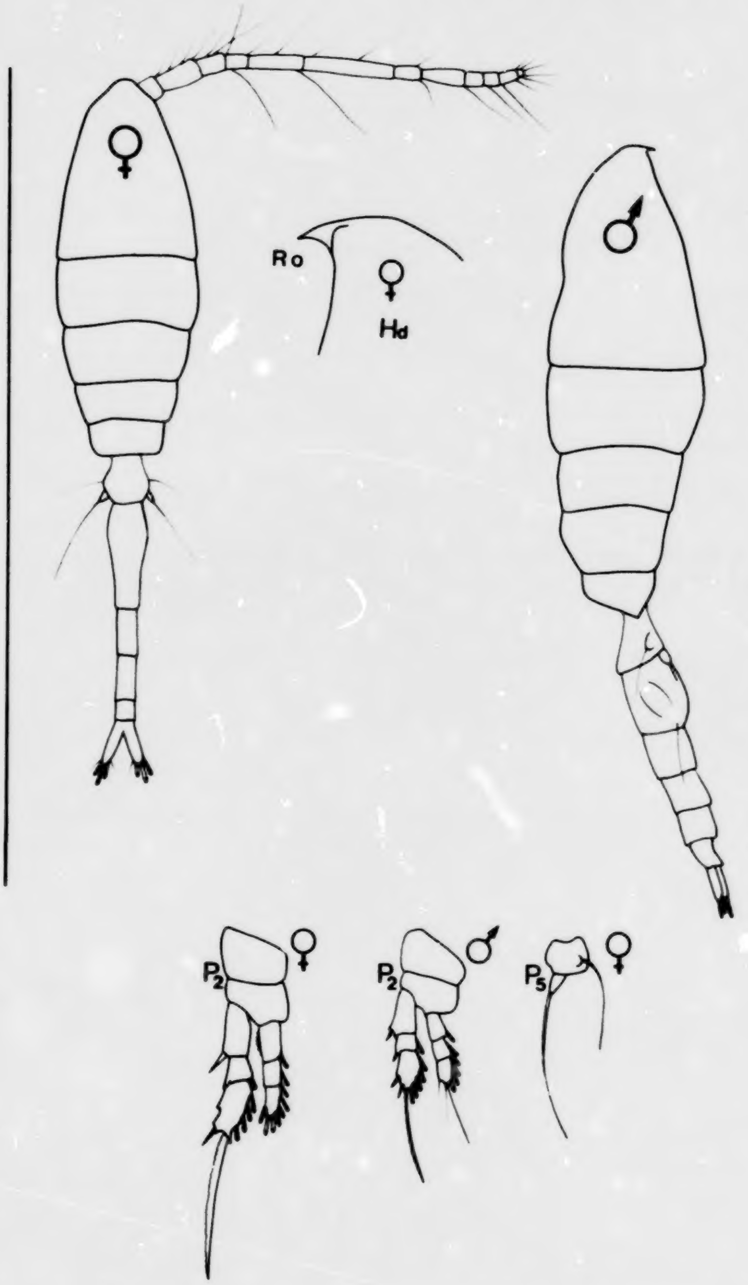
Life History:

Juveniles undescribed. The relatively short A1 (barely exceeds Pro) may allow juveniles of this species to be separated from other local members of the genus, in which the A1 reaches the ansgt.

References:

1) Davis, 1949b
2) Campbell, 1929b
3) Legare, 1957
4) Fulton, 1972
5) Cameron, 1957

6.1.1


♀
Ro
♀
Hd
♂
P2
♀
P2
♂
P5
♀

Oithona similis

from Rose, 1933

6.1.2 Oithona spinirostris Claus, 1863

Synonymy:

Oithona plumifera: Davis (1949b:part)

Morphology:

Pro elongate; Ro in female only, strong, spiniform and visible in dorsal view; P5 present as small conical segment with two apical setae (1).

FEMALE TL 1.2-1.4 mm (1); A1 reaching to ansgt.

MALE TL 0.7-0.8 mm (1); A1 articulated, shorter than Pro.

Separable from O. plumifera only by the absence of a small papilla on the ventral aspect of the female Th5.

Distribution and Occurrence:

Worldwide (2). Locally, abundant in the Strait of Georgia (3) and also reported from the vicinity of the Queen Charlotte Islands (4).

Life History:

Juveniles undescribed, key valid for adults only.

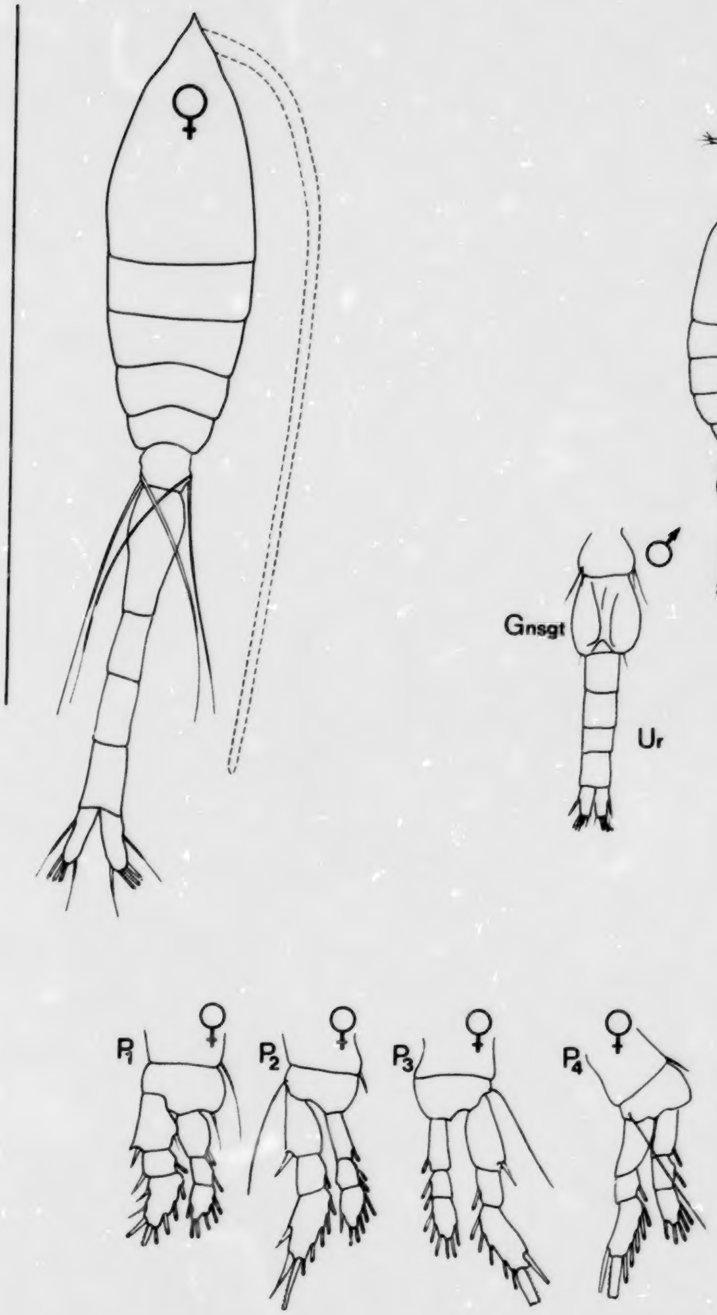
Comments:

Oithona plumifera and O. spinirostris may be synonymous (2) and need to be carefully studied if they are to be adequately separated or synonymized.

References:

1) Campbell, 1929b
2) Davis, 1949b
3) Fulton, 1972
4) Cameron, 1957

6.1.2


♀
♂
♂
Gnsgt
Ur
P1
♀
P2
♀
P3
♀
P4
♀

Oithona spinirostris

from Mori, 1937

7.1 Oncaea Philippi, 1943

Morphology:

Pro elongate, Ur variable; P1-P4 with long, slender enp, bp2 lacking seta on inner distal margin (1).

FEMALE Ur six-segmented (Ur3 elongate); A1 six-segmented (1).

MALE Ur six-segmented; gnsgt voluminous with produced lateral angles (1).

References:

1) Heron, 1977

7.1.1 *Oncaea borealis* Sars, 1918

Morphology:

Pro elongate; gnsgt approximately ½ Ur; P3 exp and enp elongate and thin (1, 2).

FEMALE TL 0.7 mm; Th 2 with dorsal projection visible in lateral view; P5 short, oval (1, 2).

MALE TL 0.4 mm; Th2 without dorsal projection; distal corners of gnsgt with pronounced lateral projections (1, 2).

Distribution and Occurrence:

Reported from the North Atlantic Ocean and adjacent temperate and Arctic waters (1). Locally, reported from the Strait of Juan de Fuca (3).

Life History:

Juveniles undescribed, key valid for adults only.

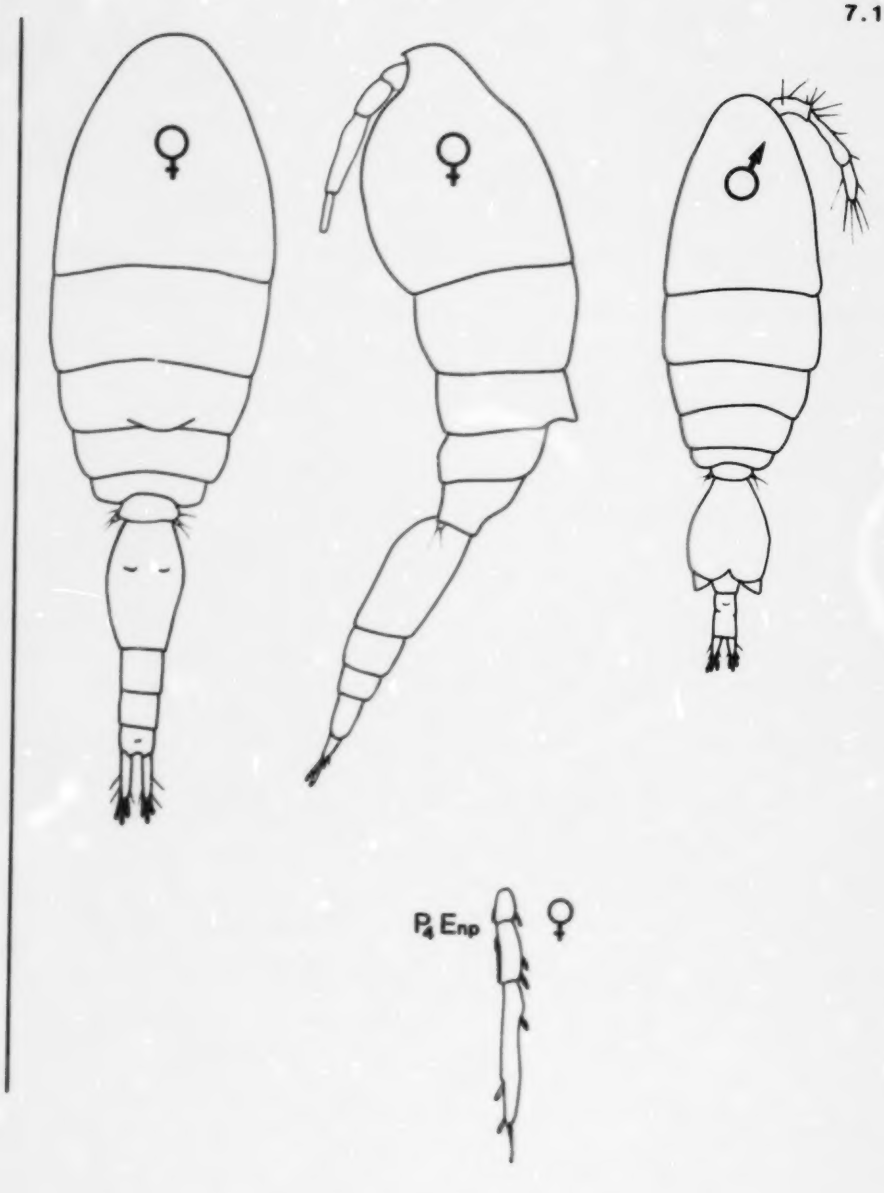
Comments:

This genus contains many species that are quite similar, especially the males. A revision of the genus is required before specific identifications can be carried out routinely and easily.

References:

1) Sars, 1918
2) Rose, 1933
3) Chester et al., 1980

7.1.1



Oncaea borealis

from Rose,1933

7.1.2 *Oncaea conifera* Giesbrecht, 1891

Morphology:

CR elongate (1).

FEMALE TL 0.75-1.4 mm; Th2 with dorsal projection visible in lateral view; gnsgt about 1.5 x as long as remainder of Ur (1).

MALE TL 0.6-0.8 mm; gnsgt about 3.0 x as long as remainder of Ur (1).

Distribution and Occurrence:

Widely distributed in all oceans (1). Locally, reported from the Strait of Juan de Fuca (2).

Life History:

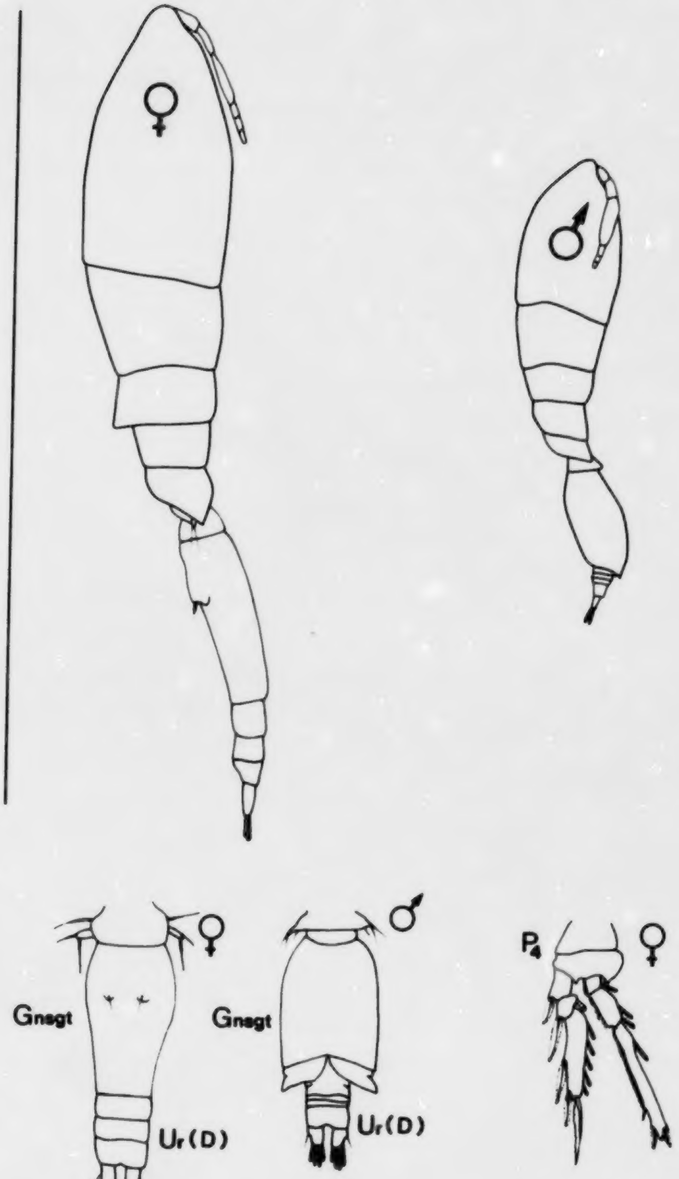
Juveniles undescribed, key valid for adults only.

Comments:

This genus contains many species that are quite similar, especially the males. A revision of the genus is required before specific identifications can be carried out routinely and easily.

References:

1) Davis, 1949b
2) Chester et al., 1980


♀
♂
♀
♂
♀
Gnsgt
Gnsgt
Ur(D)
Ur(D)
P_4

Oncaea conifera

from Mori,1937; Owre and Foyo,1967

7.1.3 Oncaea englishi Heron, 1977

Morphology:

Pro elongate, Pro:Ur ratio 1.7-1.8; gnsgt over 1/2 of Ur; A1 short; Th2 without dorsal projection, Th3 with acute, curved posteroventral corners; PLC acute, slightly curved; ansgt and CR with spinulose dorsal patches; all P1-P4 rami three-segmented, bpl without spine on distal inner margin; CR just shorter than width of ansgt (1).

FEMALE TL 0.95-1.15 mm; Ur five-segmented (1).

MALE TL 0.85-1.00 mm; Ur six-segmented (1).

Distribution and Occurrence:

Reported from the type locality, the southwest Pacific/Antarctic area (1), and locally, from the Strait of Juan de Fuca (2).

Life History:

Juveniles undescribed, key valid for adults only.

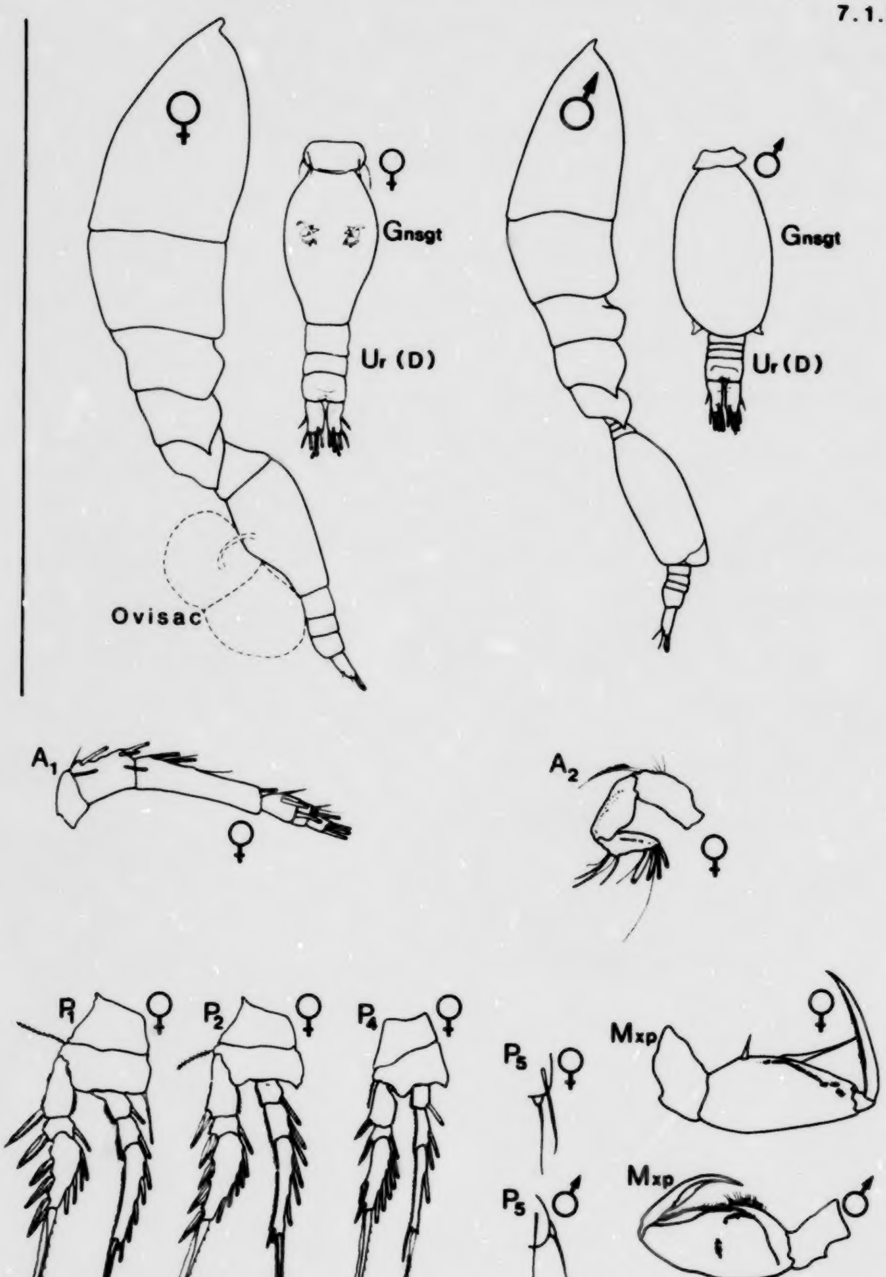
Comments:

This genus contains many species that are quite similar, especially the males. A revision of the genus is required before specific identifications can be carried out routinely and easily.

References:

1) Heron, 1977
2) Chester et al., 1980

7.1.3


♀
♀
Gnsgt
Ur (D)
Ovisac
♂
♂
Gnsgt
Ur (D)
A_1
♀
A_2
♀
P_1
♀
P_2
♀
P_4
♀
P_5
♀
Mxp
♀
P_5
♂
Mxp
♂

Oncaea englishi

from Heron, 1977

7.1.4 Oncaea ivlevi Shmeleva, 1966

Morphology:

Pro:Ur ratio approximately 2.0; Th2 lacking dorsal projection; CR approximately as long as width of ansgt. P1-P4 rami with thin, elongate terminal segments; P3,4 exp3 armed with two lateral spines; P1,2 exp3 armed with three lateral spines (1).

FEMALE TL 0.32-0.33 mm; gnsgt approximately ½ length Ur (1).

MALE TL 0.30-0.31 mm; gnsgt large, with acute distal corners. Ur2-Ur4 reduced (1).

Distribution and Occurrence:

Reported from the Adriatic Sea and tropical regions of the Atlantic Ocean between 4°59'N and 9°51'S over a wide range of depths, but more concentrated above 500m (1). Locally, reported from the Strait of Juan de Fuca (2).

Life History:

Juveniles undescribed, key valid for adults only.

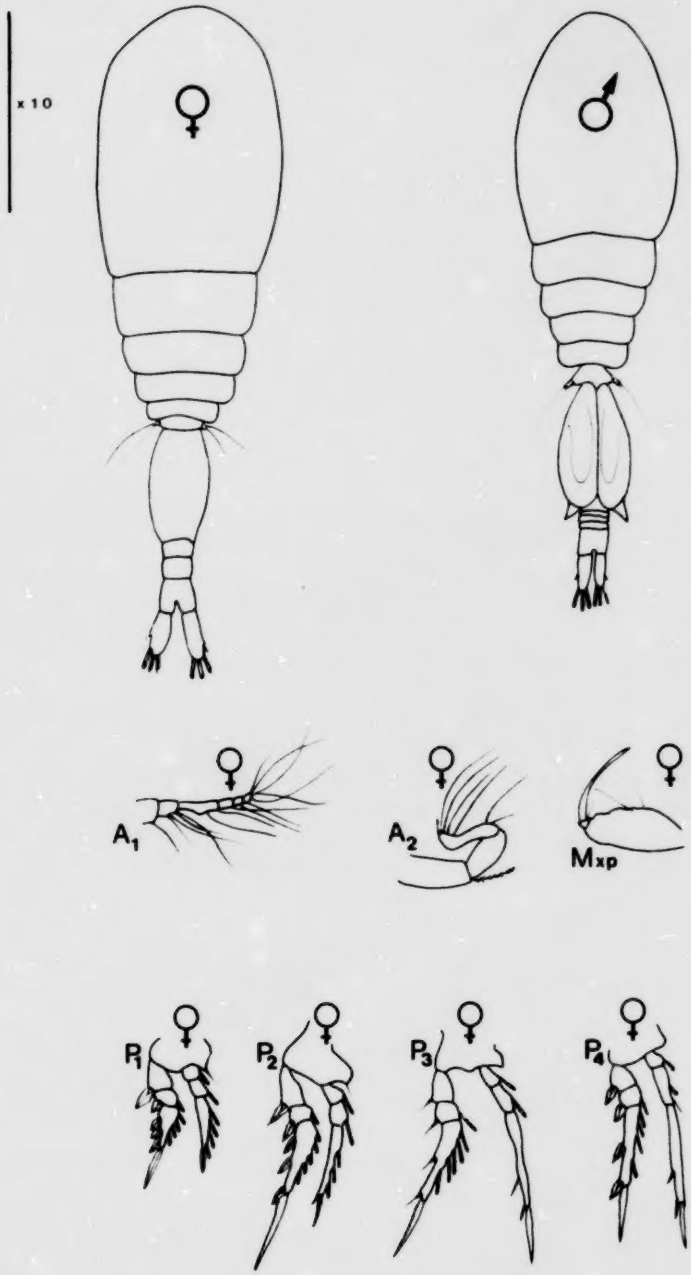
Comments:

This genus contains many species that are quite similar, especially the males. A revision of the genus is required before specific identifications can be carried out routinely and easily.

References:

1) Shmeleva, 1966, 1969
2) Chester et al., 1980

7.1.4


x10
♀
♂
♀
A_1
♀
A_2
♀
Mxp
♀
P_1
♀
P_2
♀
P_3
♀
P_4

Oncaea ivlevi

from Shmeleva, 1966

7.1.5 Oncaea prolata Heron, 1977

Synonymy:

Oncaea notopus: Giesbrecht, 1902

Morphology:

Pro elongate, Pro:Ur ratio approximately 1.9; A1 short; Th2 lacking dorsal projection; CR just shorter than width of ansgt; gnsgt just less than ½ Ur, bearing transverse rows of spinules around and below a ledge protruding anteroventrally; P1-P4 rami three-segmented, bpl without seta on distal inner margin; P2 exp3 bearing three lateral spines (1).

FEMALE TL 0.67-0.72 mm (1).

MALE Undescribed.

Distribution and Occurrence:

Reported from the type area, the southwest Pacific-Antarctic (1), and locally, from the Strait of Juan de Fuca (2).

Life History:

Juveniles undescribed, key valid for adults only.

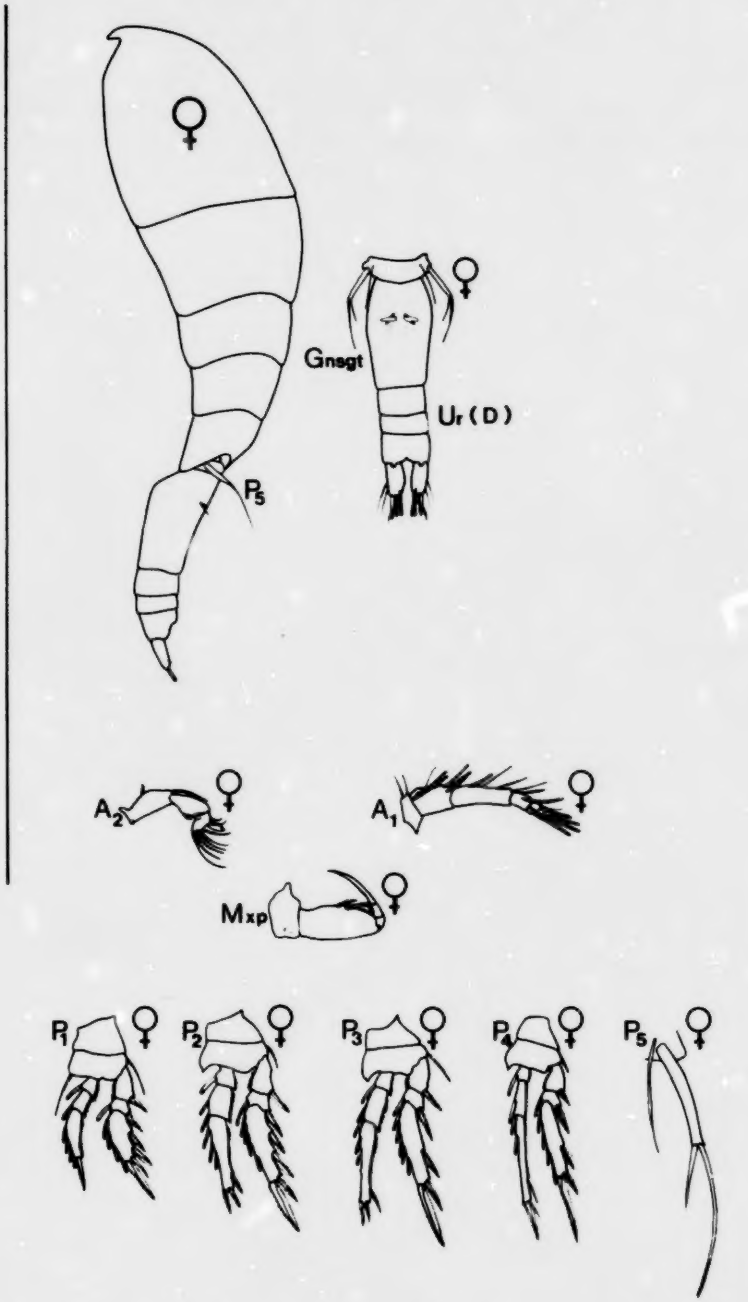
Comments:

This genus contains many species that are quite similar, especially the males. A revision of the genus is required before specific identifications can be carried out routinely and easily.

References:

1) Heron, 1977
2) Chester et al., 1980

7.1.5


♀
♀
Gnsgt
Ur(D)
P5
A2
♀
A1
♀
Mxp
♀
P1
♀
P2
♀
P3
♀
P4
♀
P5
♀

Oncaea prolata

from Heron, 1977

7.2 Lubbockia Claus, 1863

Morphology:

Pro elongate; Ur slender; A1 short, seven-segmented; P1-P4 segmentation all 3-3; P1-P4 bp2 with seta at inner margin; mxp large and easily seen; P5 one-segmented with two spines (1).

References:

1) Heron and Damkaer, 1978

7.2.1 Lubbockia minuta Wolfenden, 1905

Synonymy:

Lubbockia glacialis: Heron and Damkaer (1969)

Morphology:

Ur elongate; Ro broadly rounded; P1-P4 bpl with short seta on inner margin; P1,2 exp3 each with three spines on outer edge (1).

FEMALE TL 1.29-1.50 mm; Ur five-segmented and as long as Pro (1).

MALE TL 2.00-2.31 mm; Ur six-segmented and 1.3 x Pro (1).

Distribution and Occurrence:

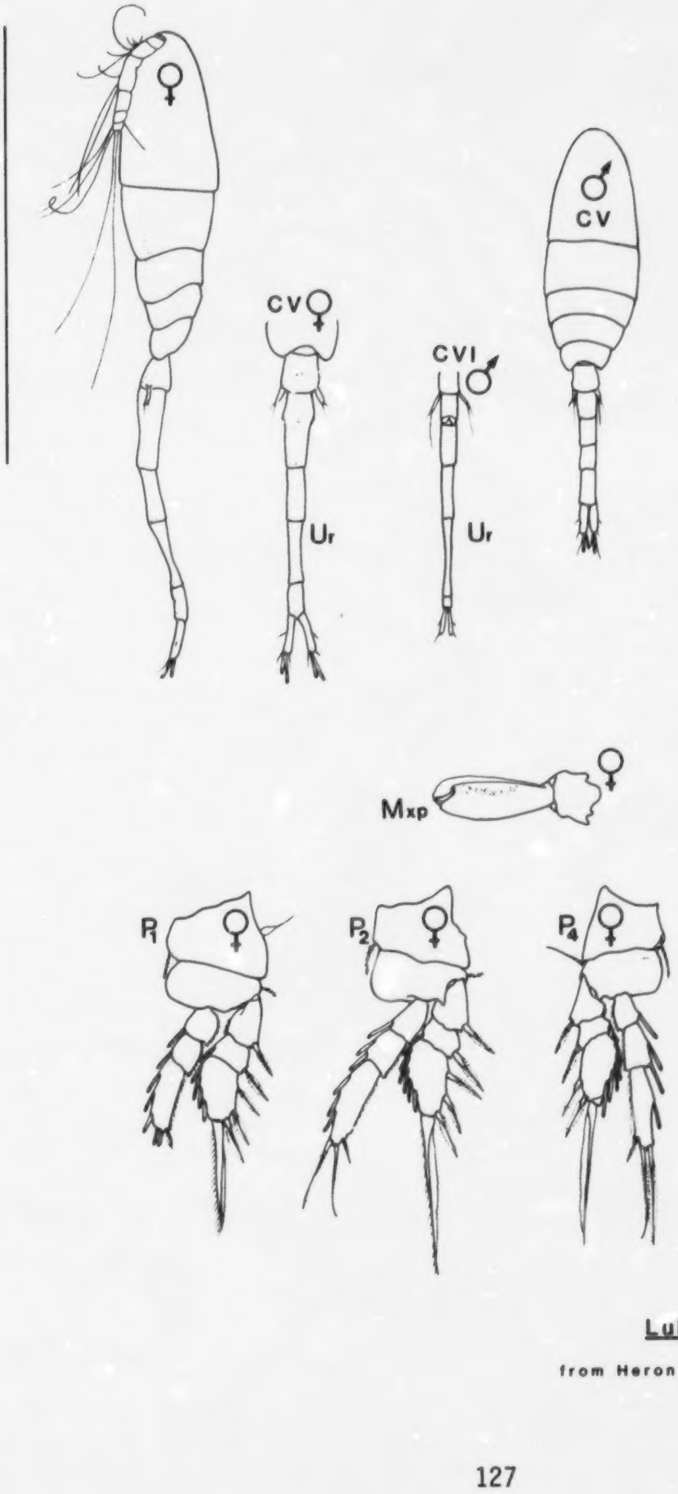
Reported from the northwestern and tropical Atlantic Ocean and the northeastern Pacific Ocean (1). Locally, reported from the Strait of Juan de Fuca (2).

Life History:

The CV ranges from 1.03 - 1.10 mm, and has a five-segmented Ur (cf. five segments in the fCVI and six in the mCVI); the CIV ranges from 0.89-0.93 mm, and has a four-segmented Ur (1). Younger stages are undescribed.

References:

1) Heron and Damkaer, 1978
2) Chester et al., 1980


♀
CV ♀
Ur
CVI ♂
Ur
CV ♂
CIV ♂
Mxp
♀
P1 ♀
P2 ♀
P4 ♀

Lubbockia minuta

from Heron and Damkaer, 1978

7.2.2 Lubbockia wilsonae Heron and Damkaer, 1969

Synonymy:

Lubbockia aculeata: Vervoort (1957)
NOT L. aculeata: Giesbrecht (1891)

Morphology:

Pro elongate, Pro:Ur ratio approximately 0.7; CR elongate; P5 elongate, rectangular; P1, 2 exp3 each with only two spines on outer margin (1).

FEMALE TL 2.60-2.98; Ro broadly rounded; Ur six-segmented (1).

MALE TL 1.96-2.08; Ro less rounded than in female; Ur five-segmented (1).

Distribution and Occurrence:

Northeast Pacific and Antarctic waters (1). Locally, rare but reported from samples collected by the Ocean Ecology Laboratory in Knight, Rivers and Loughborough Inlets.

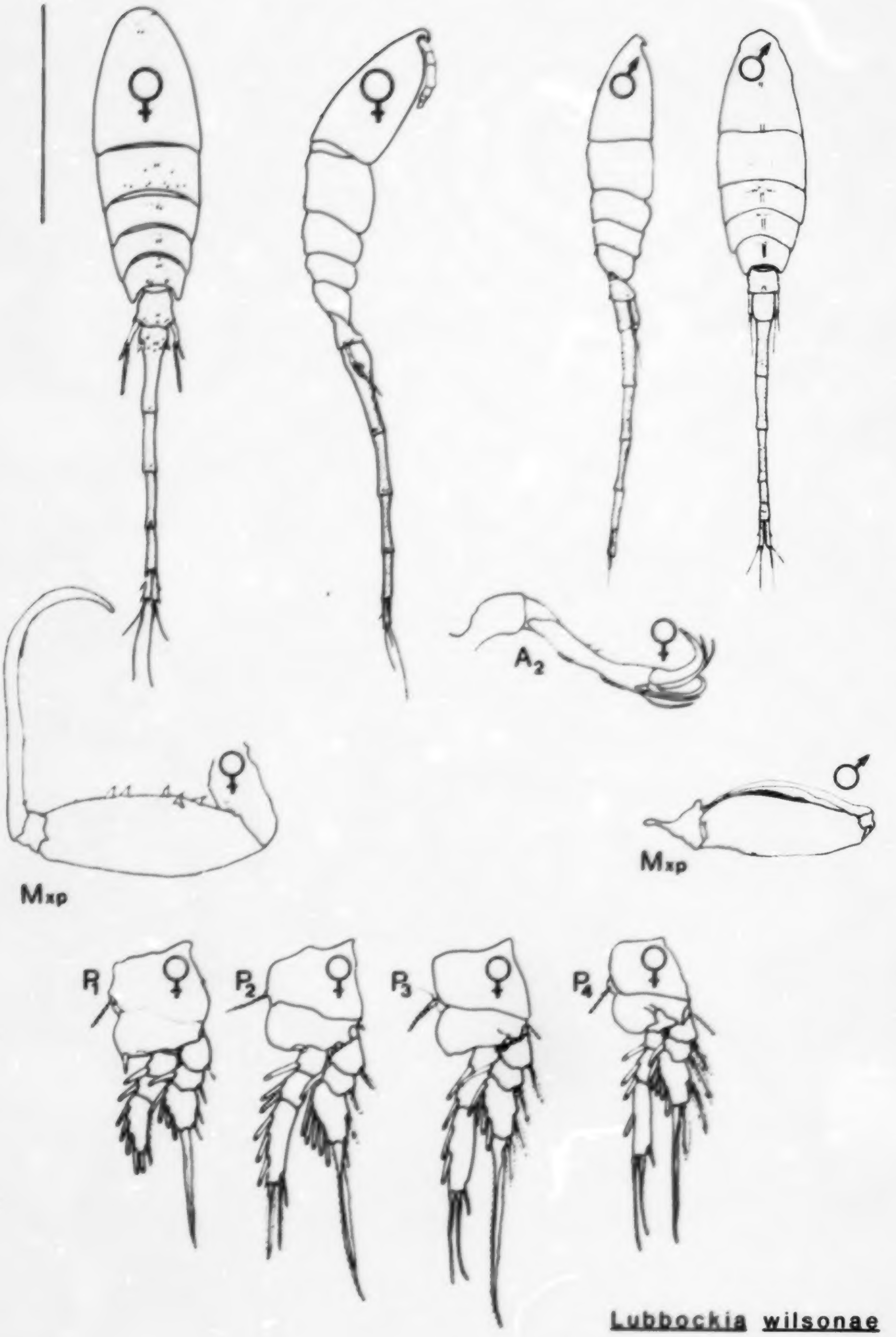
Life History:

Female CV 1.98 mm, mCV 1.75 mm; Ur five-segmented; P5 well-developed. CIV 1.48 mm; Ur four-segmented; P5 small, with two spines. CIII 0.97-1.06 mm; Ur three-segmented; P5 present as spine only (1).

References:

1) Heron and Damkaer, 1978

7.2.2


♀
♀
♂
♂
A2 ♀
♀
Mxp
♂
Mxp
P1 ♀
P2 ♀
P3 ♀
P4 ♀

Lubbockia wilsonae

from Heron and Damkaer, 1969, 1978

7.3 Pseudolubbockia Sars, 1909

Morphology:

Pro elongate; Ur slender; A1 short, five to seven segments; P1-P4 segmentation all 3-3; P1-P4 bp1 with seta at inner margin; Mxp large and easily seen; P5 one-segmented with four spines (1, 2).

References:

1) Heron and Damkaer, 1978
2) Heron and Damkaer, 1969

7.3.1 Pseudolubbockia dilatata Sars, 1909

Morphology:

Most of the body surface, appendages, and mouth parts densely covered with minute papillae or minute setules (1).

FEMALE TL 2.31-3.02 mm; PLC flared laterally, appears square in dorsal view; Ur six segments; CR twice as long as wide; A1 six-segmented (1).

MALE TL 1.35-1.40 mm; PLC flared laterally, appears rounded in dorsal view; UR five-segmented; CR almost as wide as long; A1 five-segmented with two faint sutures on terminal segment (1).

Within the study area, only one other species has a densely spinulose body surface. This is a calanoid, Centraugaptilus porcellus.

Distribution and Occurrence:

Common in Puget Sound (2) but not reported from other regions within the study area.

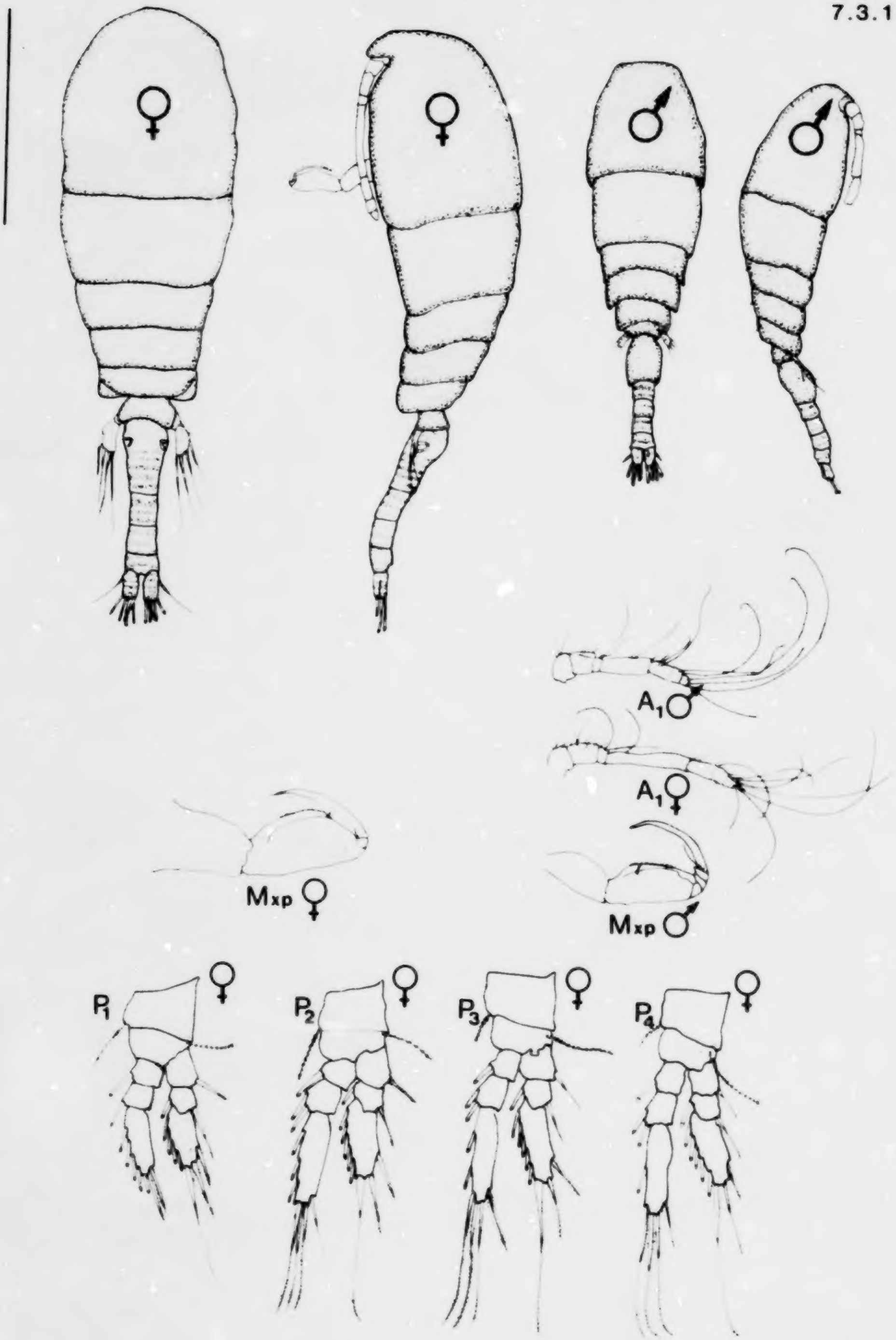
Life History:

Juveniles undescribed; late copepodite stages probably similar to those of Lubbockia wilsonae (3).

References:

1) Heron and Damkaer, 1969
2) Chester et al., 1980
3) Heron and Damkaer, 1978

7.3.1


♀
♀
♂
♂
A_1 ♂
A_1 ♀
Mxp ♀
Mxp ♂
P_1 ♀
P_2 ♀
P_3 ♀
P_4 ♀

__*Pseudolubbockia dilatata*__

from Heron and Damkaer, 1969

7.4 CALANOIDA

8.1 Calanus Leach, 1816

Synonymy:

Nannocalanus Sars, 1925

Morphology:

The least morphologically specialized genus of the order. Body fusiform; mouthparts the same in both sexes; max2 with five or six setae on first inner lobe. Swimming legs unmodified; P5 bpl with denticulate inner margin; P5 in both sexes only slightly modified (1).

FEMALE P5 enp with seven or eight setae (1).

MALE P5 enp usually with eight setae, rarely four or seven (1).

	Calanus	Neocalanus	Mesocalanus
P5 bpl denticulate	y	n	n

Comments: Genus redefined by Bradford and Jillett (1).

References:

1) Bradford and Jillett, 1974

8.1.1 Calanus marshallae Frost, 1974

Synonymy:

Calanus glacialis: Woodhouse (1971); Fulton (1972)

Morphology:

Pro:Ur ratio approximately 4; Pro fusiform; Hd smoothly rounded; PLC rounded; CR approximately as long as width of ansgt; P5 bpl inner margin denticulate; P5 bp2 with short process on distal anterior margin (1, 2).

FEMALE TL 3.2-4.2 mm; P5 enpl does not reach median distal corner of P5 expl (1).

MALE TL 3.5-4.0 mm; P5 exp slightly reduced, exp3 tapering distally (1).

Distribution and Occurrence:

Reported from the eastern North Pacific Ocean, waters adjacent to the Aleutian Islands and the eastern Bering Sea (2). South to about 40°26' N along the eastern edge of the Pacific (1). Found locally throughout the study area; occasionally very abundant, especially in spring (April, May). Second only to Neocalanus plumchrus in terms of biomass contribution to the zooplankton.

Life History:

The juvenile stages have not been described; however, their sizes are known (3). The CV is similar to the adult and can be identified directly using the key, but may be confused with the smaller C. pacificus or the larger Neocalanus plumchrus.

Total Length (mm):

CV	2.8-3.8	CIII	1.6-2.3
CIV	2.3-2.6	CII	1.2-1.5
		CI	0.5-0.7

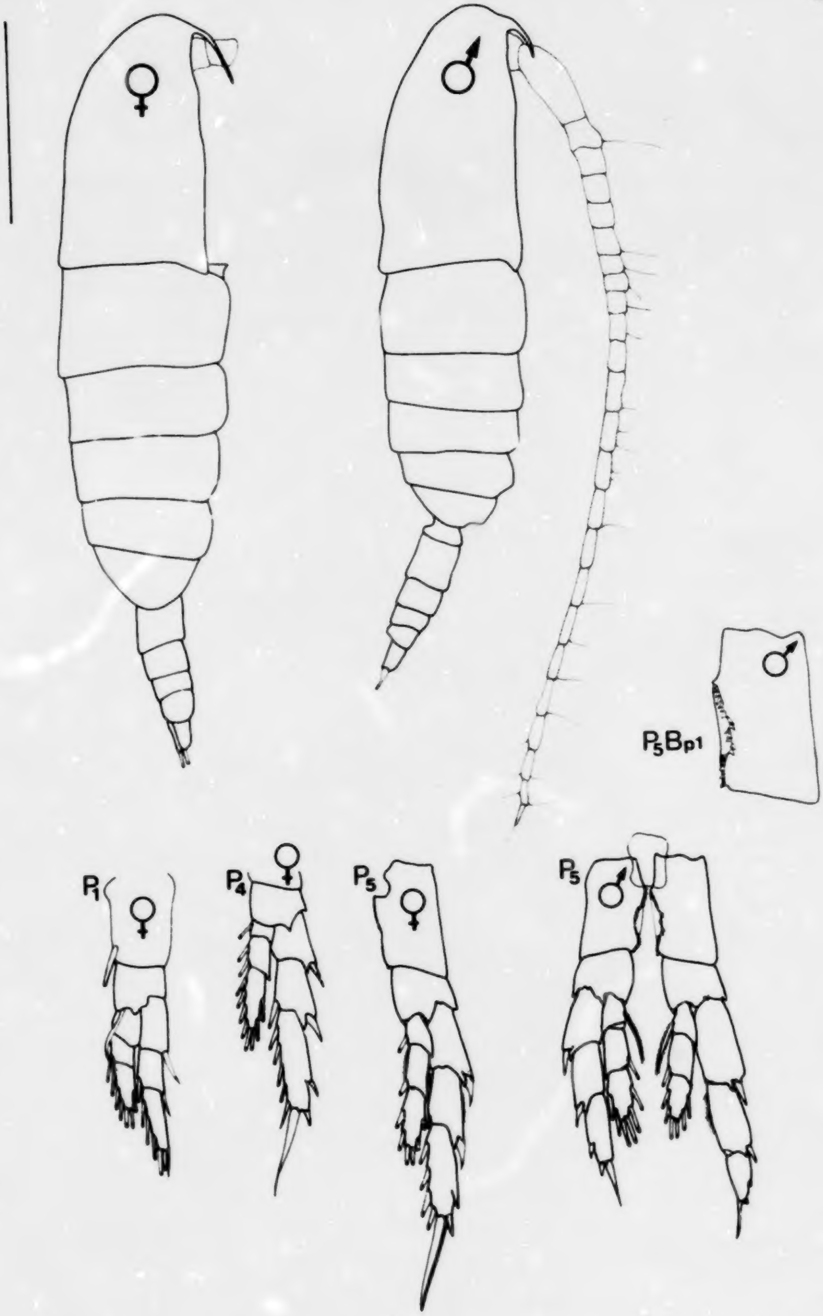
Comments:

Because of its high population biomass, C. marshallae may be locally important in the diet of planktivorous fishes (e.g. young salmonids; herring). The species is a major component of the food web in most locations along the coast.

References:

1) Woodhouse, 1971
2) Frost, 1974

8.1.1


♀
♂
P5Bp1 ♂
P1 ♀
P4 ♀
P5 ♀
P5 ♂

Calanus marshallae

from Woodhouse, 1971

8.1.2 *Calanus pacificus* s.l. Brodsky, 1948

Synonymy:

Calanus finmarchicus: Esterly (1924)
Calanus sp.: Shan (1962)

Morphology:

Pro:Ur ratio approximately 4; Pro fusiform; Hd rounded, but somewhat angular in lateral view; P5 bp2 with an elongate, spiniform process on distal anterior margin; P4 bpl inner margin denticulate (1).

FEMALE TL 2.6-3.0 mm; P5 enpl extends nearly to, or beyond median distal corner of P5 expl (1).

MALE TL 2.5-2.8 mm; P5 exp slightly reduced, exp3 tapering distally (1).

Distribution and Occurrence:

Reported from across the North Pacific, but its distribution is not continuous and the species apparently consists of three geographically discrete sub-species (2). The easternmost of these sub-species, *Calanus pacificus californicus*, extends from the northern end of the Baja Peninsula to Dixon Entrance (1, 3).

Life History:

The juvenile stages have not been fully described; however, their sizes are known (4). The CV is similar to the adult and can be identified directly from the key, but may be confused with *C. marshallae*.

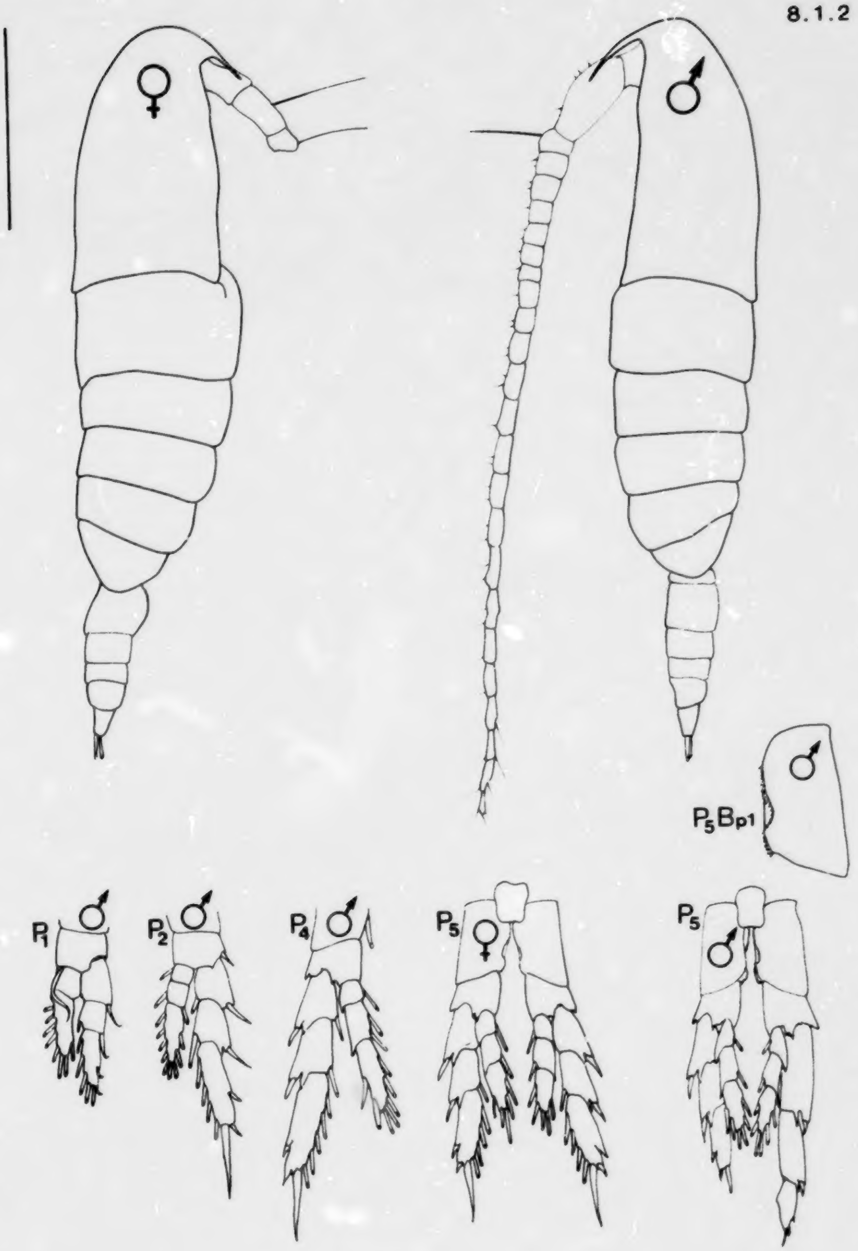
Total Length (mm):

CV	2.5-2.8	NVI	0.61
CIV	1.8	NV	0.55
CIII	1.5	NIV	0.48
CII	1.2	NIII	0.40
CI	0.5	NII	0.27
		NI	0.22

References:

1) Woodhouse, 1971
2) Brodsky, 1962
3) Gardner, unpublished data
4) Fulton, 1972

8.1.2


♀
♂
P5Bp1
♂
P1 ♂
P2 ♂
P4 ♂
P5 ♀
P5 ♂

Calanus pacificus s.l.

from Woodhouse,1971

8.2 Neocalanus Sars, 1925

Morphology:

Body fusiform; mouthparts reduced in male and sometimes in female; max2 with six setae on first inner lobe. P2 expl with recurved spine on outer distal border. P5 bpl inner margin not denticulate, lft mP5 modified, enp usually with eight setae (1).

	Calanus	Neocalanus	Mesocalanus
P5 bpl denticulate	y	n	n
Total Length	2.6-4.0	4.3-10.4	1.5-2.4

Comments:

Genus redefined by Bradford and Jillett (1).

References:

1) Bradford and Jillett, 1974

8.2.1 *Neocalanus cristatus* (Kroyer, 1848)

Synonymy:

Calanus cristatus: Giesbrecht (1892); Campbell (1929b); Mori (1937); Brodsky (1938, 1950); Tanaka (1956a); Davis (1949b)

Morphology:

Pro elongate, fusiform; Hd cristate; PLC rounded; A1 exceeds TL; CR short; P5 bpl with smooth inner margin (1).

FEMALE TL 8.5-10.4 mm; gnsgt strongly swollen, slightly wider than long; Ur short (1).

MALE TL 9.0-9.8 mm; Hd crest reduced in comparison with female; Ur2 longest Ur segment, almost as long as wide; P5 exp3 reduced (1).

Distribution and Occurrence:

Reported from the North Pacific Ocean, Bering Sea, Seas of Japan and Okhotsk (1). Locally, rare but reported from the Strait of Georgia (2), Queen Charlotte Sound, Hecate Strait, Dixon Entrance and adjacent waters (3, 4).

Life History:

The juveniles are not fully described; however, the CIV and CV are similar to the adult and conform to the characters used in the key. Length ranges have been reported for all copepodite stages (2).

Total Length (mm):	
CV	7.1-8.9
CIV	4.9-5.3
CIII	3.2
CII	2.0
CI	1.2

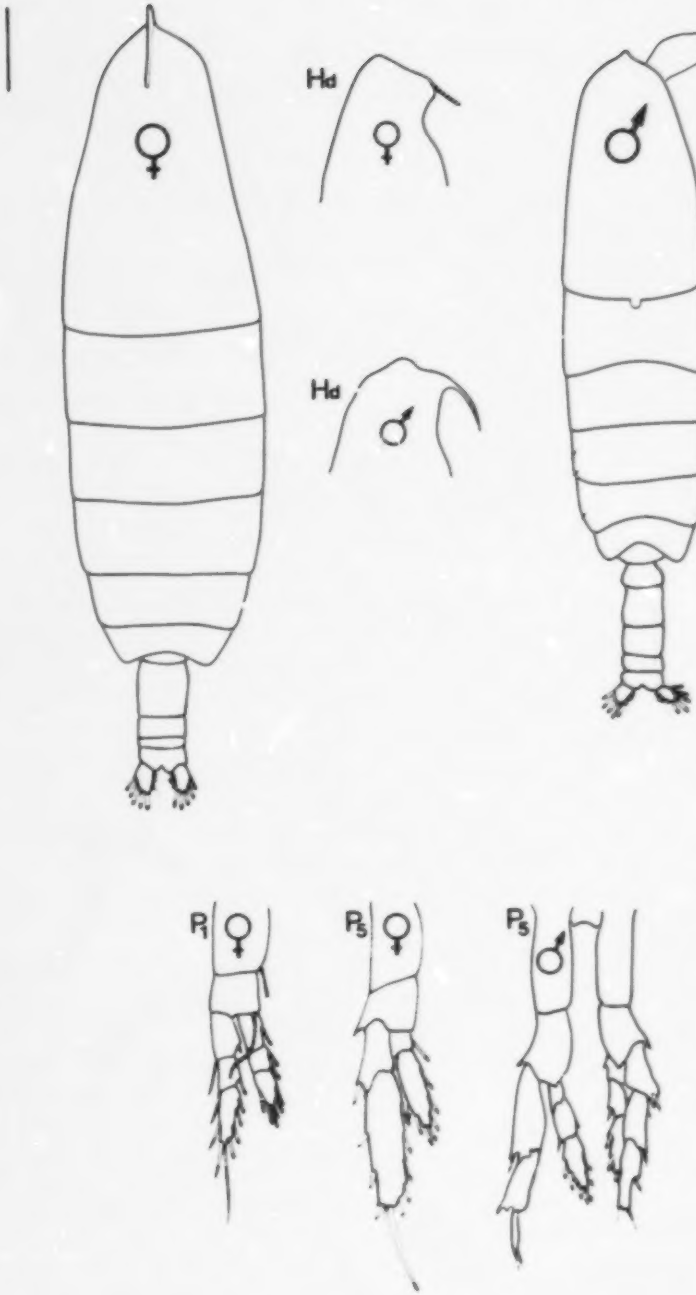
Comments:

In terms of biomass, *N. cristatus* is one of the dominant zooplankters in the North Pacific and as such is an important component of the food web. Locally, it is too rare to have a large impact on energy transfer, but it may be important as an indicator of intrusions of oceanic water into inshore areas (3, 4).

References:

1) Brodsky, 1950
2) Fulton, 1972
3) Gardner, 1982a
4) Gardner, 1982b

8.2.1


♀
Hd
♀
♂
Hd
♂
P1 ♀
P5 ♀
P5 ♂

Neocalanus cristatus

from Mori,1937; Brodsky,1950

8.2.2 *Neocalanus plumchrus* (Marukawa, 1921)

Synonymy:

Calanus plumchrus: Marukawa (1921); Mori (1937); Tanaka (1956b)
C. tonsus: Campbell (1929b, 1930, 1934a); Davis (1949b); Tanaka (1954)

Morphology:

Pro fusiform; Pro:Ur ratio about 5; Hd and PLC rounded; A1 approximately equal TL; inner margin of P5 bpl smooth (1, 2).

FEMALE TL 4.5-5.1 mm (3).

MALE TL 4.3-4.8 mm; P5 slightly reduced, exp3 tapering distally (1, 3).

Distribution and Occurrence:

Widely distributed in the North Pacific. Found throughout the range covered in the key, but adults generally restricted to depths below 250 m.

Life History:

All stages are fully described (1), and their life history studied (4). The dominant stage during most of the year is the CV, which overwinters in deep water. In January and February, the CV molts to the adult. Adult females each produce several hundred eggs fertilized and released at depth. Young naupliar stages ascend to near surface where they can completely dominate the plankton in early spring. Growth proceeds to the CV, which descends to depth in August or September and begins to overwinter. The male and female are short-lived and usually disappear by April. Overwintering CV's and adults feed minimally or not at all. The characters used in this key will also allow identification of the CV and CIV, but may be confused with juveniles of *C. marshallae*.

Total Length (mm):

CV	4.1-5.2	CIII	1.8.2.4	NVI	0.70	NIII	0.35
CIV	2.8-3.4	CII	1.2-1.5	NV	0.56	NII	0.30
		CI	0.9-1.3	NIV	0.46	NI	0.29

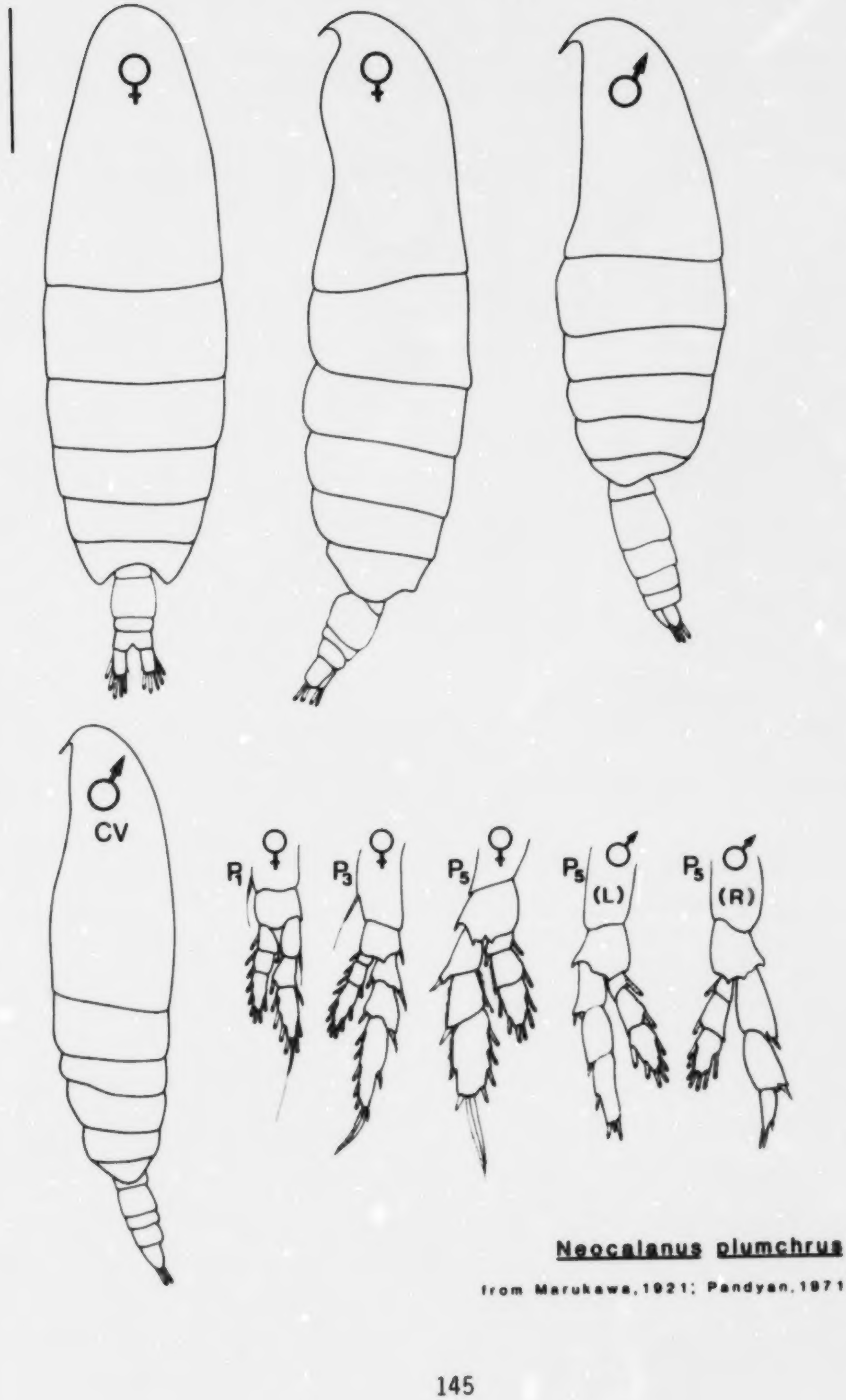
Comments:

In the Strait of Georgia, this species serves as an important food source for young salmonids, herring and other planktivores, and dominates the secondary production (4, 5).

References:

1) Campbell, 1934
2) Bradford and Jillett, 1974
3) Fulton, 1972
4) Fulton, 1973
5) Parsons et al., 1969

8.2.2


♀
♀
♂
♂
CV
P1 ♀
P3 ♀
P5 ♀
P5 ♂ (L)
P5 ♂ (R)

Neocalanus plumchrus

from Marukawa, 1921; Pandyan, 1971

8.3 Mesocalanus Bradford and Jillett, 1974

Morphology:

Body fusiform, generally small in size; max2 with six setae on first inner lobe. PI-P4 unmodified; P5 bpl inner margin smooth, P5 enp with seven setae (1).

FEMALE No specific information.

MALE Mouthparts reduced (1).

	Calanus	Neocalanus	Mesocalanus
P5 bpl denticulate	y	n	n
Number of setae, lft mP5 enp	8	8	7

Comments:

Genus erected by Bradford and Jillett (1).

References:

1) Bradford and Jillett, 1974

8.3.1 Mesocalanus tenuicornis (Dana, 1849)

Synonymy:

Calanus tenuicornis: Dana (1853); Giesbrecht (1892); Esterly (1905); Vervoort (1946); Farran and Vervoort (1951a); Brodsky (1950); Bowman (1955)

Morphology:

Pro:Ur ratio approximately 3.0; five thoracic segments; P1 expl with spine on outer distal corner; P5 bpl with smooth inner margin; CR relatively long (1).

FEMALE TL 1.8-2.4 mm; A1 exceed TL by seven or more segments; gnsgt moderately swollen, protruding ventrally (1).

MALE TL 1.5-1.9 mm; spines on dorsal surface of Th3 - Th4; A1 slightly longer than TL; mouthparts reduced; P5 slightly asymmetrical; lft P5 exp3 reduced, narrowing distally (1, 2).

Separable from most other local taxa by size, the presence of a rostrum, and the elongate A1; however, the A1 may be broken off in preserved samples.

Distribution and Occurrence:

Widespread in temperate and subtropical zones. Reported from the Atlantic, Pacific and Indian Oceans, the Mediterranean Sea, and adjacent waters but nowhere abundant (1, 2). Locally, rare and not usually found in protected waters. More abundant on the continental shelf (e.g. Queen Charlotte Sound, Hecate Strait, Dixon Entrance) and adjacent waterways (4).

Life History:

The juveniles are undescribed; however, the characters used in the key should allow identification of the CV.

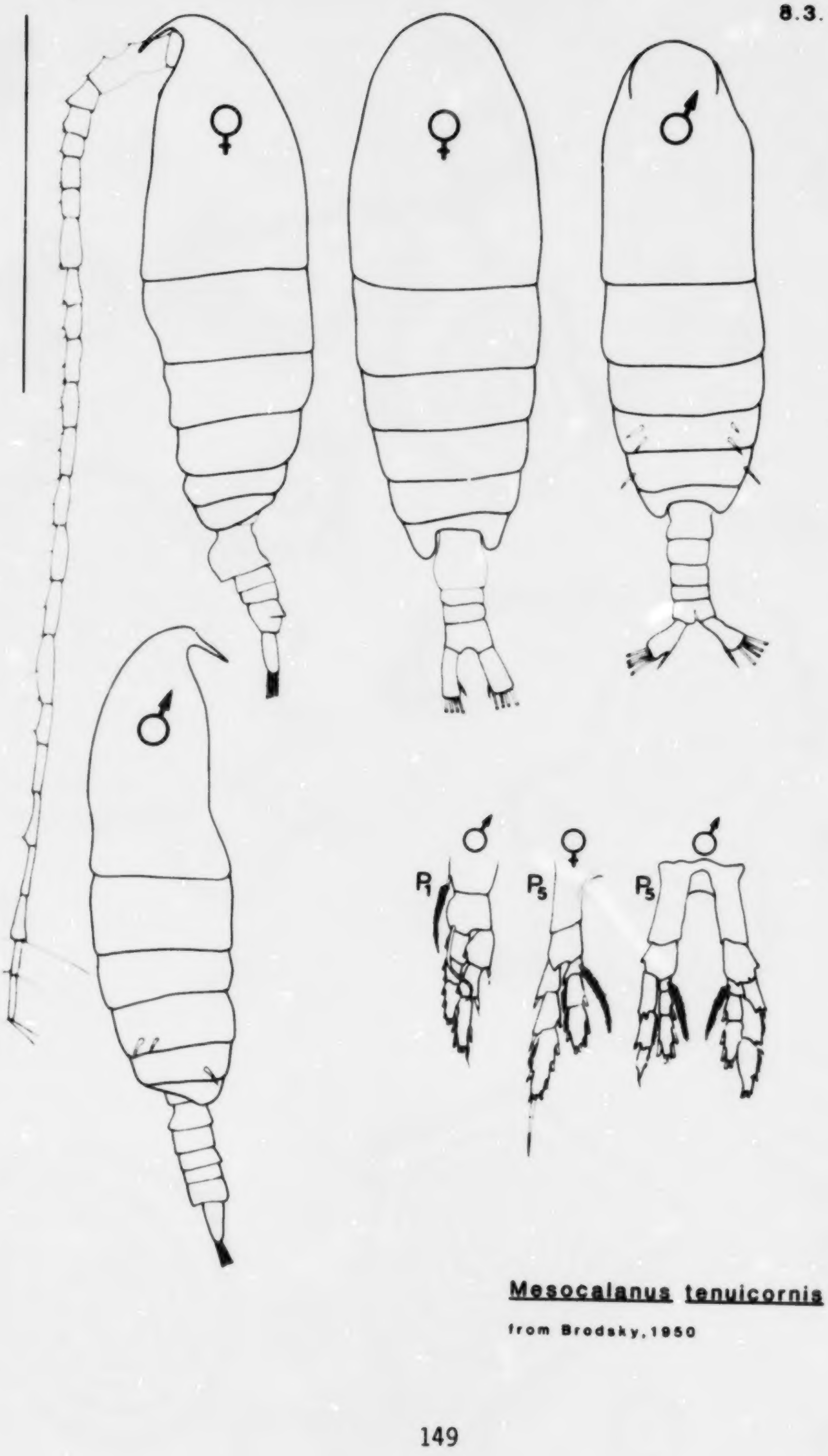
Comments:

Not economically important, but may be an important indicator of an intrusion of equatorial water (4).

References:

1) Brodsky, 1950
2) Farran and Vervoort, 1951a (Fiches, Sheet 32)
3) Chester et al., 1980
4) Gardner, 1982a

8.3.1



Mesocalanus tenuicornis

from Brodsky, 1950

9.1 Eucalanus Dana, 1852

Morphology:

Hd elongate and narrowed apically; body highly transparent, with elongate cephalosome and large gap between mouthparts and swimming legs. Ro with long filaments; A1 longer than total length. P1 exp-enp segmentation: 3-2 or 2-2, CR fused with ansgt.

FEMALE P5 absent (1, 2).

MALE P5 uniramous, mouthparts reduced (1, 2).

The elongate cephalosome and gap between mouthparts and swimming legs are distinctive and readily seen in all copepodite stages.

References:

1) Brodsky, 1950
2) Farran and Vervoort, 1951c (Fiches, Sheet 34)

9.1.1 *Eucalanus bungii* Giesbrecht, 1892

Synonymy:

Eucalanus elongatus var. *bungii*: Giesbrecht (1892); Johnson (1937)
E. giesbrechti: Mori (1937)
E. bungii bungii: Johnson (1938); Brodsky (1950); Tanaka (1956a); Fulton (1972)
E. elongatus: Campbell (1929b)

Morphology:

Pro elongate; conspicuous gap between mxp and PI visible in all copepodite stages; Hd produced anteriorly, bluntly triangular apex; PLC rounded; AI exceeding CR by about four segments; PI exp3 with two spines on outer margin; md bp2 with three setae; ansgt fused with CR (1).

FEMALE TL 6.0-8.0 mm; Ur four-segmented (including fused CR/ansgt) (1).

MALE TL 4.8-5.5 mm; Ur five-segmented (including fused CR/ansgt) (1).

Separable from other local *Eucalanus* by the presence of two spines on the outer margin of PI exp3 and three setae on the md bp2. The latter character is the only point separating *E. bungii* from *E. californicus*, and may be difficult to verify in males due to the reduction of the mouthparts.

Distribution and Occurrence:

Boreal and sub-Arctic in the North Pacific, Bering Sea and adjacent waters (2). Locally, ubiquitous but more numerous in the Strait of Georgia and with occasional high densities at specific locations along the coast (3, 4).

Life History:

The juveniles are well described (5).

Total Length (mm):

fCV	4.9-5.2	fCIV	3.36-3.8	CIII	2.9-3.0
mCV	4.5-4.8	mCIV	3.4-3.7	CII	2.0-2.2
				CI	1.3-1.6

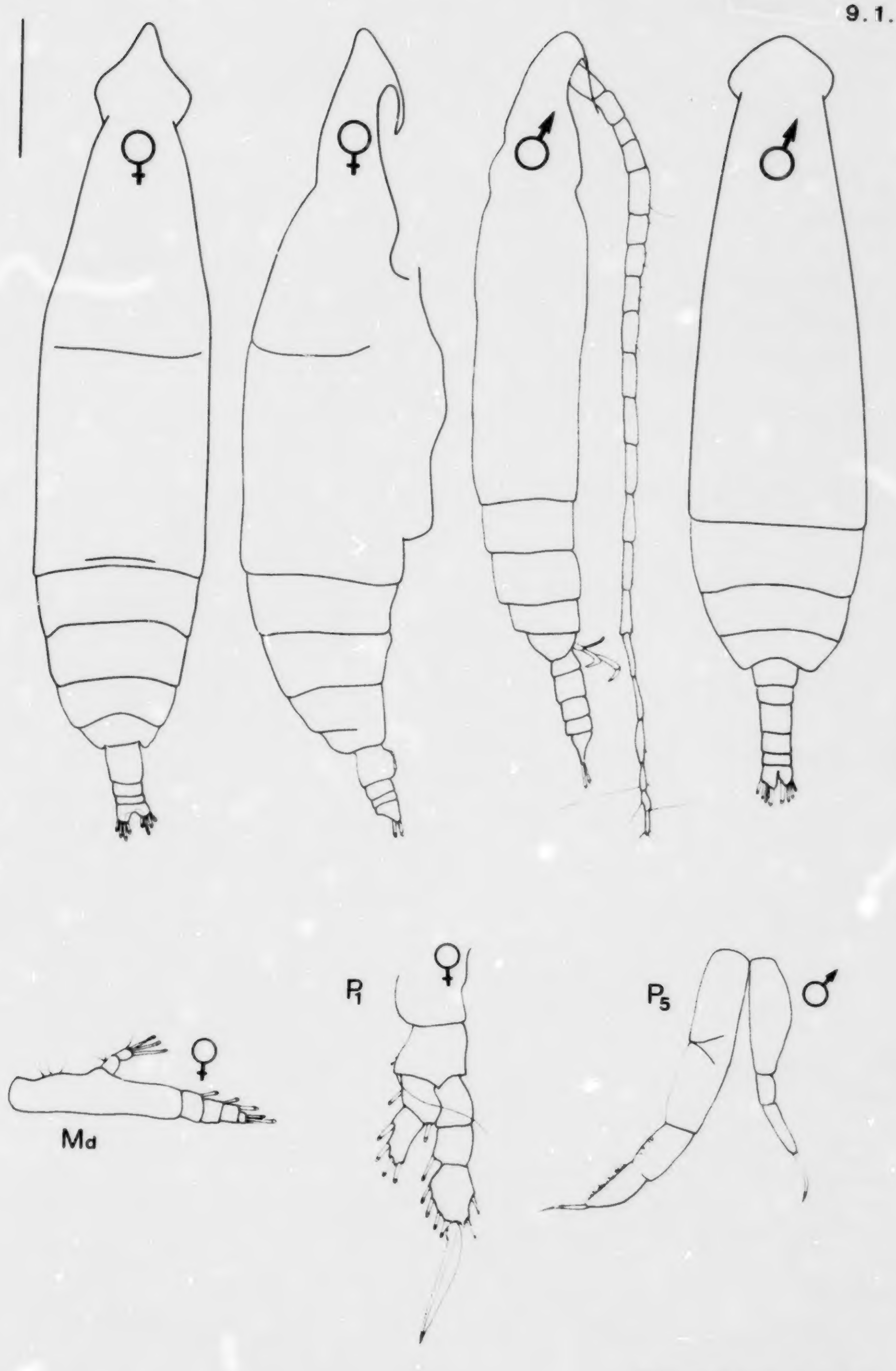
Comments:

Occasionally abundant, rarely dominant. The species of *Eucalanus* are all very similar in gross morphology. Historical records of *E. bungii* in the British Columbia coastal zone may include small numbers of other members of the genus (3, 5).

References:

1) Johnson, 1938
2) Brodsky, 1950
3) Krause and Lewis, 1979
4) Gardner, 1982a
5) Johnson, 1937

9.1.1



Eucalanus bungii

from Fleminger 1973; Park, 1968; male original

9.1.2 Eucalanus californicus Johnson, 1938

Synonymy:

Eucalanus bungii californicus: Johnson (1938); Brodsky (1950); Tanaka (1956a)
E. elongatus: Esterly (1905)

Morphology:

Pro elongate; conspicuous gap between mxp and PI visible in all copepodite stages; Hd produced anteriorly, bluntly triangular apex; PLC rounded; PI exp3 with two outer edge spines; md bpl with only one seta; AI exceed TL and one AI may exceed the other in length (1).

FEMALE TL 5.9-7.0 mm; Ur four-segmented (including fused CR/ansgt) (1).

MALE TL 4.7-5.0 mm; Ur five-segmented (including fused CR/ansgt) (1).

Separable from other local Eucalanus by the presence of two outer edge spines on the PI exp3 and of only one seta on the md bpl. The latter character is the only character separating males of E. californicus from E. bungii, and may be difficult to verify due to the reduction in the mouthparts.

Distribution and Occurrence:

Reported from the temperate North Pacific; particularly from the California coast (2). Locally rare, but reported from the vicinity of Malcolm Island in Queen Charlotte Strait (3).

Life History:

Juveniles have not been described, but should be similar in general form to those of E. bungii (4).

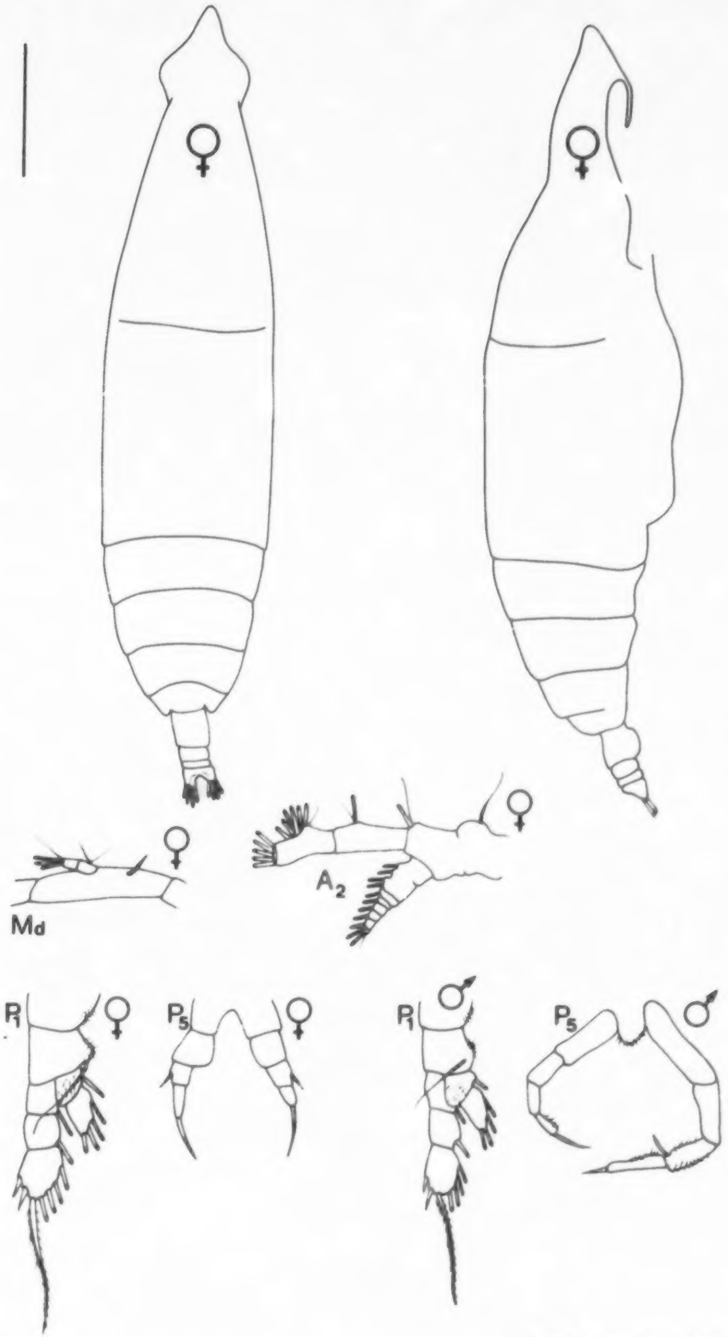
Comments:

Because E. bungii and E. californicus are very difficult to differentiate in the adult, many records of E. bungii may involve both species. The distribution and abundance of both species in British Columbia waters should be re-examined. E. californicus may be an indicator of water originating to the south (e.g. off the coast of California).

References:

1) Johnson, 1938
2) Brodsky, 1950
3) Davis, 1949b
4) Johnson, 1937

9.1.2


♀
♀
♀
Md
A2
♀
P1
♀
P5
♀
P1
♂
P5
♂

Eucalanus californicus

from Johnson,1938; Fleminger,1973

9.1.3 Eucalanus hyalinus (Claus, 1866)

Morphology:

Hd slightly elongate; PLC pointed and slightly elongate; dorsal surface of thorax lightly spinulose; PI exp3 with single spine on outer margin; md bp2 with three lateral setae (1).

FEMALE TL 4.5-5.8 mm (1).

MALE TL 3.2-5.0 mm; lft P5 elongate, similar in length to P4 (1).

Due to the great similarity between local members of this genus, records of E. hyalinus from the British Columbia coast should be interpreted with caution. Nevertheless, it is possible to separate the species in most stages. E. hyalinus is unique in the possession of a single spine on P1 exp3 (vs two spines in other local members of the genus), and can also be identified, in the adult female, by the pattern of integumental organs (2).

Distribution and Occurrence:

Reported from the North Atlantic, Indian Ocean and Mediterranean Sea (1). Locally, reported from the California coast (3, 4) and from near Port Townsend, Washington (5).

Life History:

The juveniles have not been described; however, E. bungii has been completely described (6), and E. hyalinus will follow basically the same pattern. The characters used in the key should identify the CV and possibly CIV.

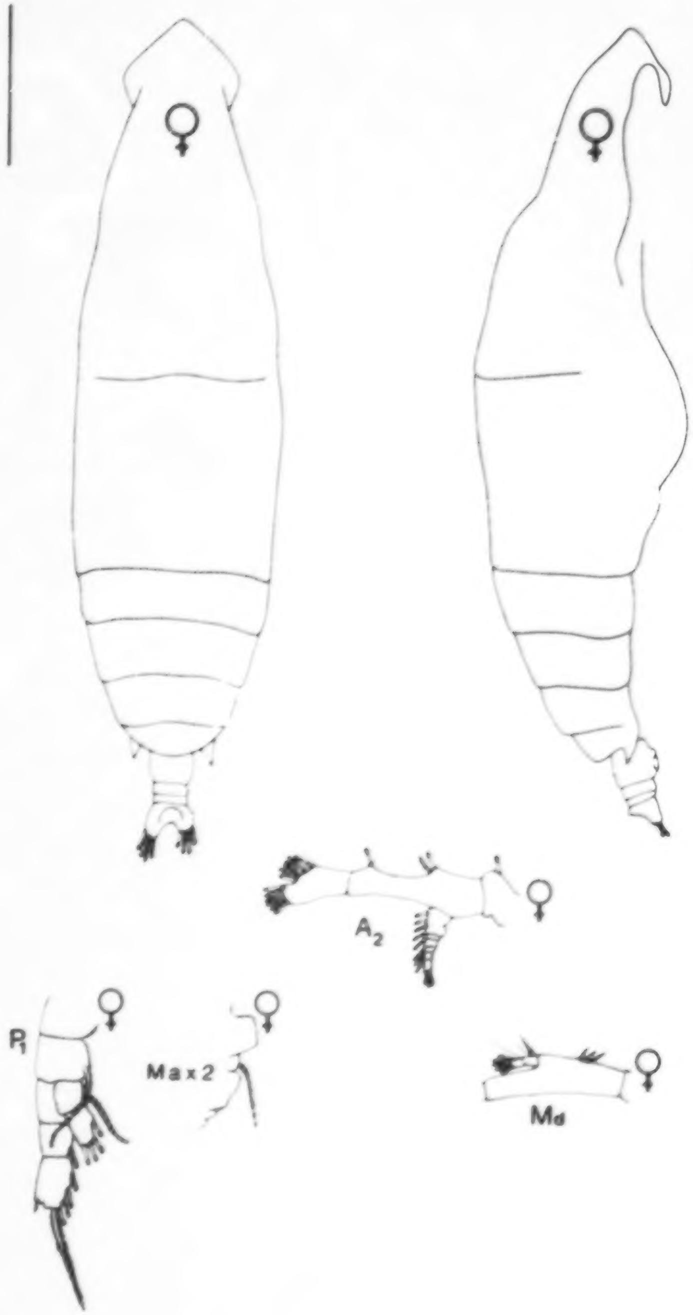
Comments:

May not occur in the study area other than as a rare immigrant from California coastal waters.

References:

1) Brodsky, 1950
2) Fleminger, 1973
3) Esterly, 1905
4) Johnson, 1938
5) Davis, 1949b
6) Johnson, 1937

9.1.3


♀
♀
A_2
♀
P_1
♀
Max2
♀
Md
♀

Eucalanus hyalinus

from Johnson, 1938; Fleminger, 1973

9.2 Rhincalanus Dana, 1852

Morphology:

Head elongate and narrowed apically; Ro prominent, with two basally spaced filaments. AI much longer than total length. Cephalosome elongate, but without space between mouthparts and swimming legs. PI segmentation: 2-2; CR fused with ansgt (1, 2).

FEMALE Ur three-segmented; P5 reduced, uniramous (1).

MALE Ur four-segmented; lft P5 biramous, exp reduced, one-segmented, enp two-segmented, segments stout, fringed with hairs; rt P5 uniramous, two-segmented, distal segment armed with a long curved apical spine (1, 2).

The elongate cephalosome, triangular head and placement of mouthparts are distinctive.

References:

1) Brodsky, 1950
2) Farran and Vervoort, 1951c (Fiches, Sheet 34)

9.2.1 *Rhincalanus nasutus* Giesbrecht, 1888

Morphology:

Pro elongate anteriorly, but without obvious gap between mxp and P1; Hd produced anteriorly to a smoothly rounded, triangular apex; Th1, 2, 3 each with acute backward-directed projections originating from lateral distal margin (1).

FEMALE TL 3.6-5.1 mm; Ur three-segmented, gnsgt with two dorsal spines; P5 uniramous, 2P5 with inner distal seta, 3P5 with one inner and two apical setae (1).

MALE TL 2.7-3.8 mm; lft P5 biramous, enp two-segmented, spinose; rt P5 uniramous, distal segment with large, curved apical spine (1).

Distribution and Occurrence:

Widespread in deep water. Reported from the Barents, Norwegian and Greenland Seas, and the Atlantic, Pacific and Indian Oceans (1). Locally, rare and restricted to open water stations. Recorded from the vicinity of the Queen Charlotte Islands (2) and Queen Charlotte Strait (3).

Life History:

Information on the NII to NVI has been summarized and the sizes recorded below (4). The NI may not occur as a free-living stage in the plankton, with the NII hatching directly from the egg.

Total Length (mm):

NVI	1.16	NIII	0.68
NV	1.0	NII	0.46
NIV	0.85		

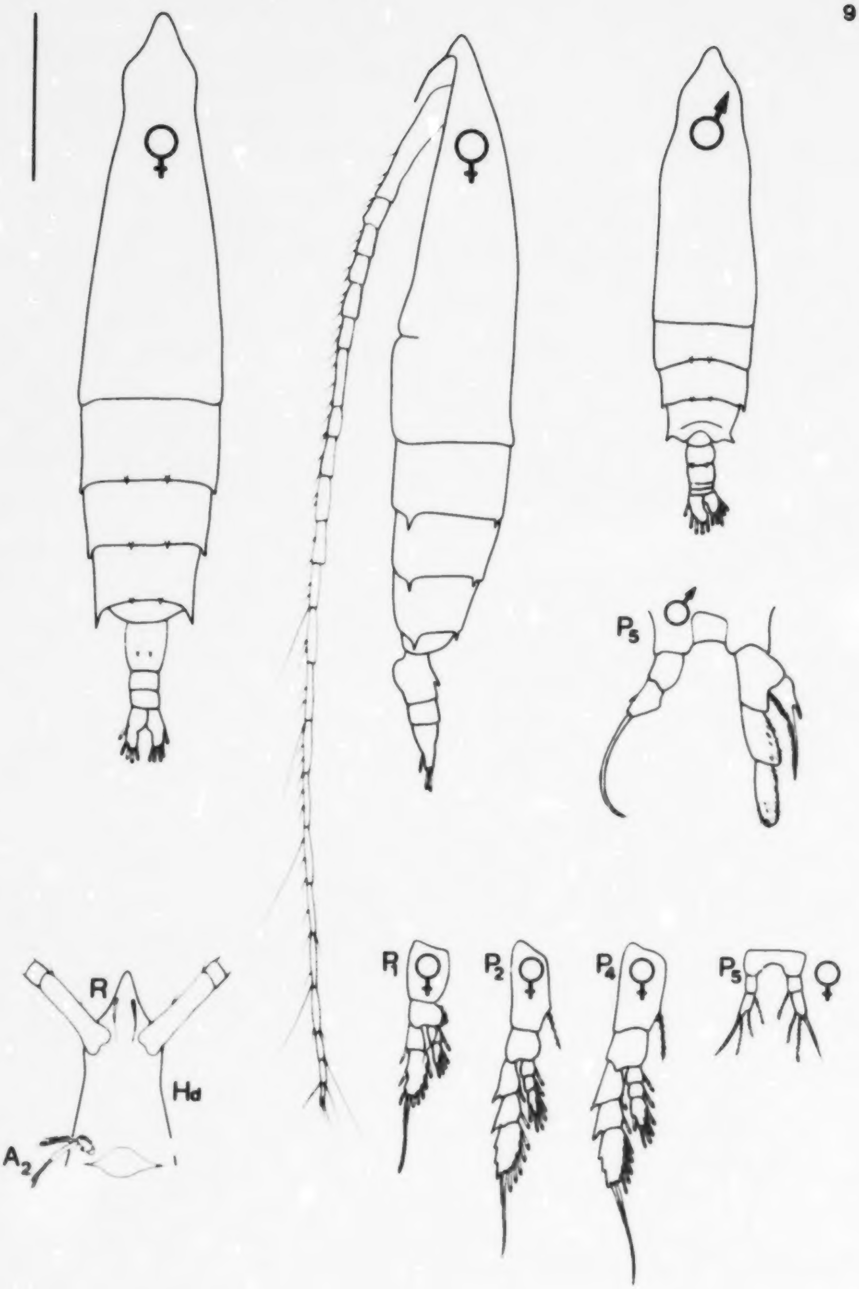
Comments:

Unlikely to occur except at deep, open water stations, or in intrusions of water from offshore.

References:

1) Brodsky, 1950
2) Cameron, 1957
3) Stone, 1980
4) Gurney, 1934

9.2.1


♀
♀
♂
P5 ♂
R
Hd
A2
P1 ♀
P2 ♀
P4 ♀
P5 ♀

Rhincalanus *nasutus*

from Sars, 1903; Mori, 1937; Brodsky, 1950

10.1 Calocalanus Dana, 1849

Morphology:

Small copepods between 0.36 and 1.30 mm in total length. P1 bp1 without seta at inner distal corner (1).

FEMALE Ur short and wide, with 2-4 segments; gnsgt globular (1).

MALE Ur usually with five segments; ansgt twice as long as preceding segment (1).

References:

1) Bernard, 1958

10.1.1 Calocalanus styliremis Giesbrecht, 1888

Morphology:

Pro robust; Ro bifurcate; Ur short; A1 greatly exceeds TL; three thoracic segments (1).

FEMALE TL 0.50-0.95 mm; Ur three-segmented, but Ur2 reduced and may be difficult to see; gnsgt globular; P5 symmetrical, three-segmented, distal segment with a single elongate spine (1).

MALE TL 0.48-0.50 mm; Ur five-segmented; lft P5 five-segmented, rt P5 three-segmented (1).

Distribution and Occurrence:

Likely world-wide, except in polar seas, although nowhere abundant. Locally, reported from the Strait of Juan de Fuca (2).

Life History:

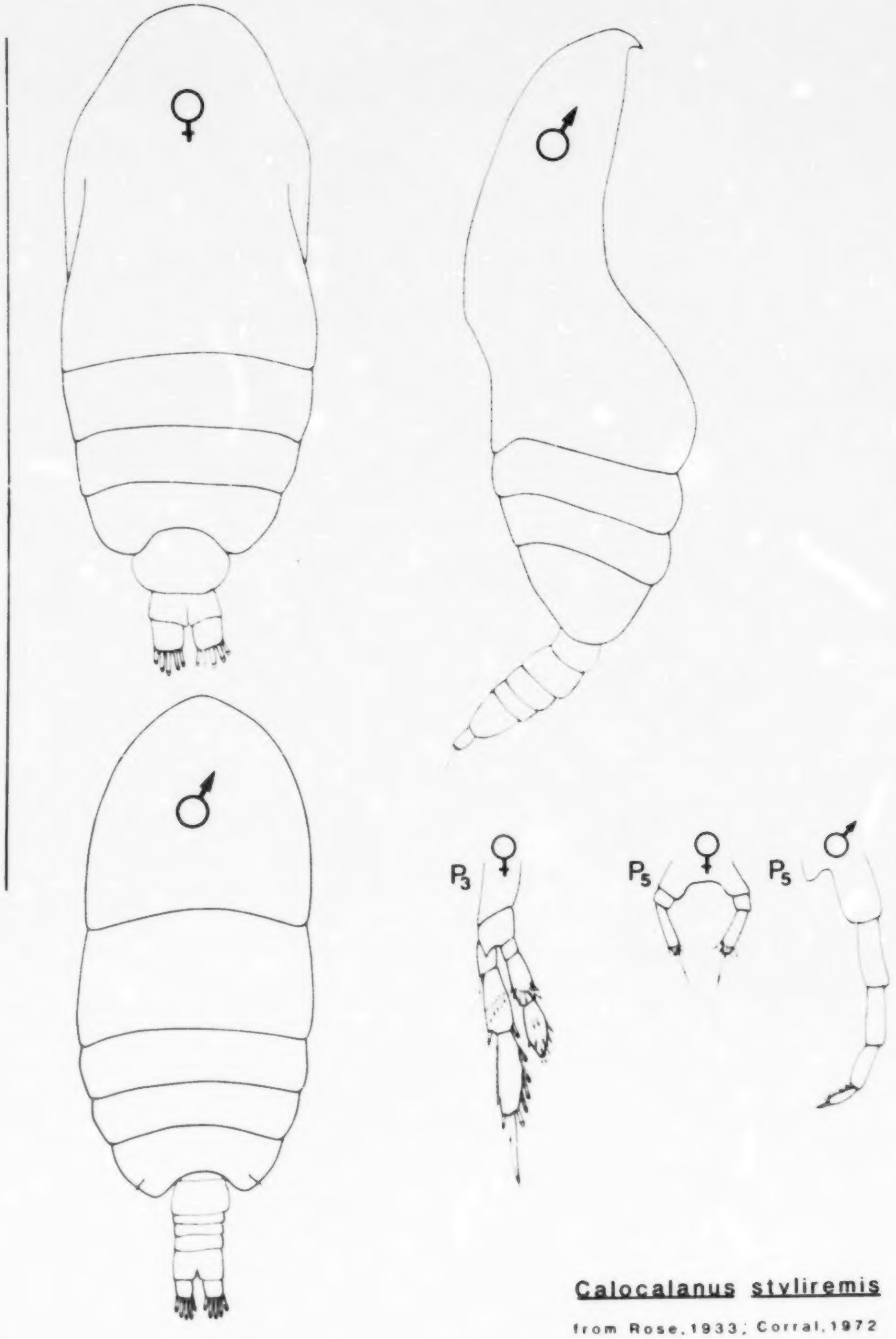
Juveniles undescribed, key valid for adults only.

Comments:

This and similar small species will be undersampled by most collecting techniques. The use of finer mesh nets may result in more extensive records for the study area.

References:

1) Corral, 1972 (Fiches, Sheet 138)
2) Chester et al., 1980



Calocalanus styliremis

from Rose, 1933; Corral, 1972

11.1 Paracalanus Boeck, 1864

Morphology:

Small, oval-bodied copepods with rounded Hd and PLC; Ro consists of two thin filaments. A2 rami subequal; CR short. P1 segmentation 3-2; P3,4 exp with serrate outer margin (1, 2).

FEMALE Ur four-segmented; P5 symmetrical, short, uniramous, two-segmented (1, 2).

MALE Ur five-segmented; P5 asymmetrical, uniramous, rt P5 two-segmented; lft P5 five-segmented (1, 2).

	Paracalanus	Pseudocalanus	Clausocalanus or Microcalanus	Ctenocalanus
mP5 very short on one side only	n	n	y	n
fP5 present	y	n	+	y
P1, 2 segmentation	3-2/3-3	3-1/3-2	3-1/3-2	3-1/3-2
P1 expl with outer edge spine	y	y	n	?
P3,4 exp outer edge spines ctenate	n	n	n	y

References:

1) Brodsky, 1950
2) Farran and Vervoort, 1951d (Fiches, Sheet 35)
3) Farran and Vervoort, 1951e (Fiches, Sheet 37)

11.1.1 Paracalanus parvus (Claus, 1863)

Morphology:

Pro stocky, widest in anterior third; Hd rounded; Ro with two short filaments; A1 reach distal segments of Ur; P2,3 enp with spinous outer surfaces, exp3 with serrate outer margin, exp apical spine smooth, not serrate (1).

FEMALE TL 0.7-1.2 mm; Ur four-segmented; P5 symmetrical, uniramous, reduced and often difficult to see; P5 two- or sometimes three-segmented (1).

MALE TL 0.8-1.4 mm; Ur five-segmented, max2 reduced, mxp atrophied; P5 asymmetrical, uniramous; lft P5 five-segmented; rt P5 two-segmented, slightly longer than lP5 (1).

Distribution and Occurrence:

Cosmopolitan in all seas with the exception of polar regions (2). Locally, recorded from the Vancouver Island region (4). Reported also from the vicinity of the Queen Charlotte Islands (5). Not usually abundant, although historical records of abundance are difficult to confirm due to confusion with Pseudocalanus. The species is abundant in the Strait of Georgia (6) and also reported from the Strait of Juan de Fuca (7).

Life History:

The nauplii have been briefly described and their sizes recorded (8). Juvenile copepods have not been described, but the characters used in the key should allow identification of the CV.

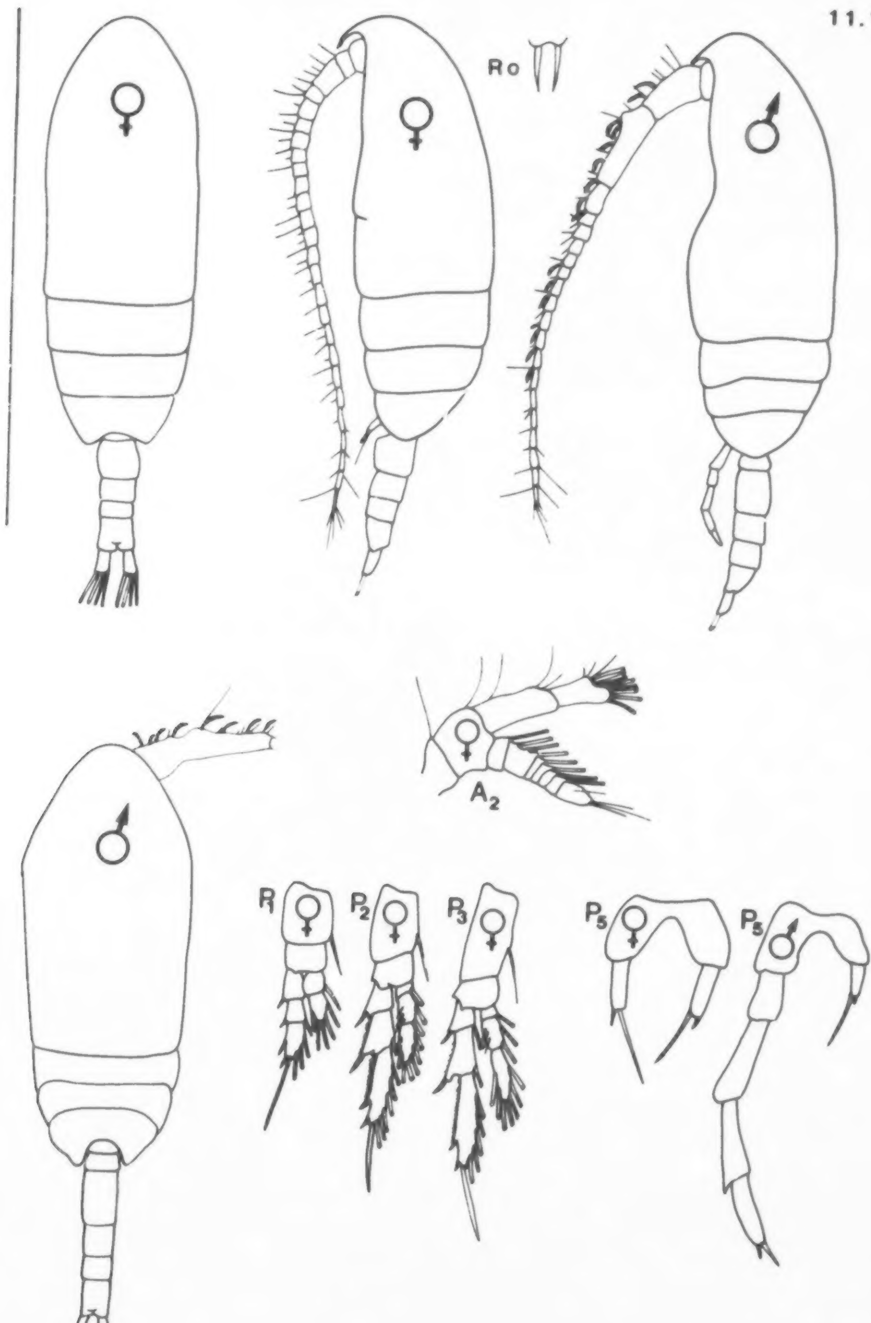
Total Length (mm):

NVI	0.25	NIII	0.16
NV	0.24	NII	0.11
NIIII	0.21	NI	0.09

References:

1) Brodsky, 1950
2) Vervoort, 1963
3) Campbell, 1929b
4) Cameron, 1957
5) Fulton, 1972
6) Chester et al., 1980
7) Ogilvie, 1953 (Fiches, Sheet 50)

11.1.1


♀
♀
Ro
♂
♂
♀
A_2
P_1 ♀
P_2 ♀
P_3 ♀
P_5 ♀
P_5 ♂

Paracalanus parvus

from Sars,1903

12.1 *Pseudocalanus* Boeck, 1872

Synonymy:

Clausia: Boeck, 1872
Lucullus: Giesbrecht, 1882

Morphology:

Small copepod; P1,2 segmentation: 3-1/3-2; A1 short; Ro composed of two slender filaments. PLC and Hd rounded; P2-P4 exp3 apical spines narrow and serrate (1, 2).

FEMALE P5 absent, occasionally rudimentary (1, 2).

MALE P5 uniramous, styliform and asymmetrical (1, 2).

	Pseudocalanus	*Clausocalanus* or *Microcalanus*	*Scolecithricella*	*Paracalanus*
mP5 very short on one side only	n	y	n	y
fP5 present	n	+	y	y
P1,2 segmentation	3-1/3-2	3-1/3-2	3-1/3-2	3-2/3-3
P1 exp1 with outer edge spine	y	n	+	y
P2 with surface spination	n	n	y	y

Comments:

This genus contains a number of similar and poorly defined species and is in need of a complete revision (3).

References:

1) Brodsky, 1950
2) Farran and Vervoort, 1951e (Fiches, Sheet 37)
3) Corkett and McLaren, 1978

12.1.1 *Pseudocalanus* cf. *minutus* (Kroyer, 1845)

Synonymy:

Clausia elongata: Boeck (1872)
Lucullus acuspes: Giesbrecht (1882)
Calanus minutus: Kroyer (1845)
Pseudocalanus elongatus: McMurrich (1916); Campbell (1929b); Wailes (1929); Johnson (1932)

Morphology:

Pro slender; Ur thin, slightly elongate; Pro:Ur ratio approximately 2; Ro of two slender filaments; PI expl with outer distal spine, spine longer than exp2 (1).

FEMALE TL 0.7-2.0 mm; gnsgt almost as long as the two following segments combined, AI barely reach beyond Ur2; P5 absent (1).

MALE TL 1.1-1.4 mm; ansgt reduced; AI reach end Ur2; lft P5 five-segmented, rt P5 four-segmented (1).

Distribution and Occurrence:

The genus *Pseudocalanus* is basically northern boreal, and extends across the Arctic. Southern limits of distribution are not well documented, but extend south to about 40°N latitude only along cool, coastal margins (1). Locally, extremely abundant throughout the area and often numerically dominant in the larger zooplankton (2, 3, 4).

Life History:

All juvenile and naupliar stages of *Pseudocalanus* have been described (1). Size ranges have been reported for all stages of *P. minutus* (2).

Total Length (mm):

CV	1.1-1.4	CIII	0.8-0.9	NVI	0.44	NIII	0.26
CIV	1.1	CII	0.6-0.7	NV	0.38	NII	0.18
		CI	0.6	NIV	0.33	NI	0.18

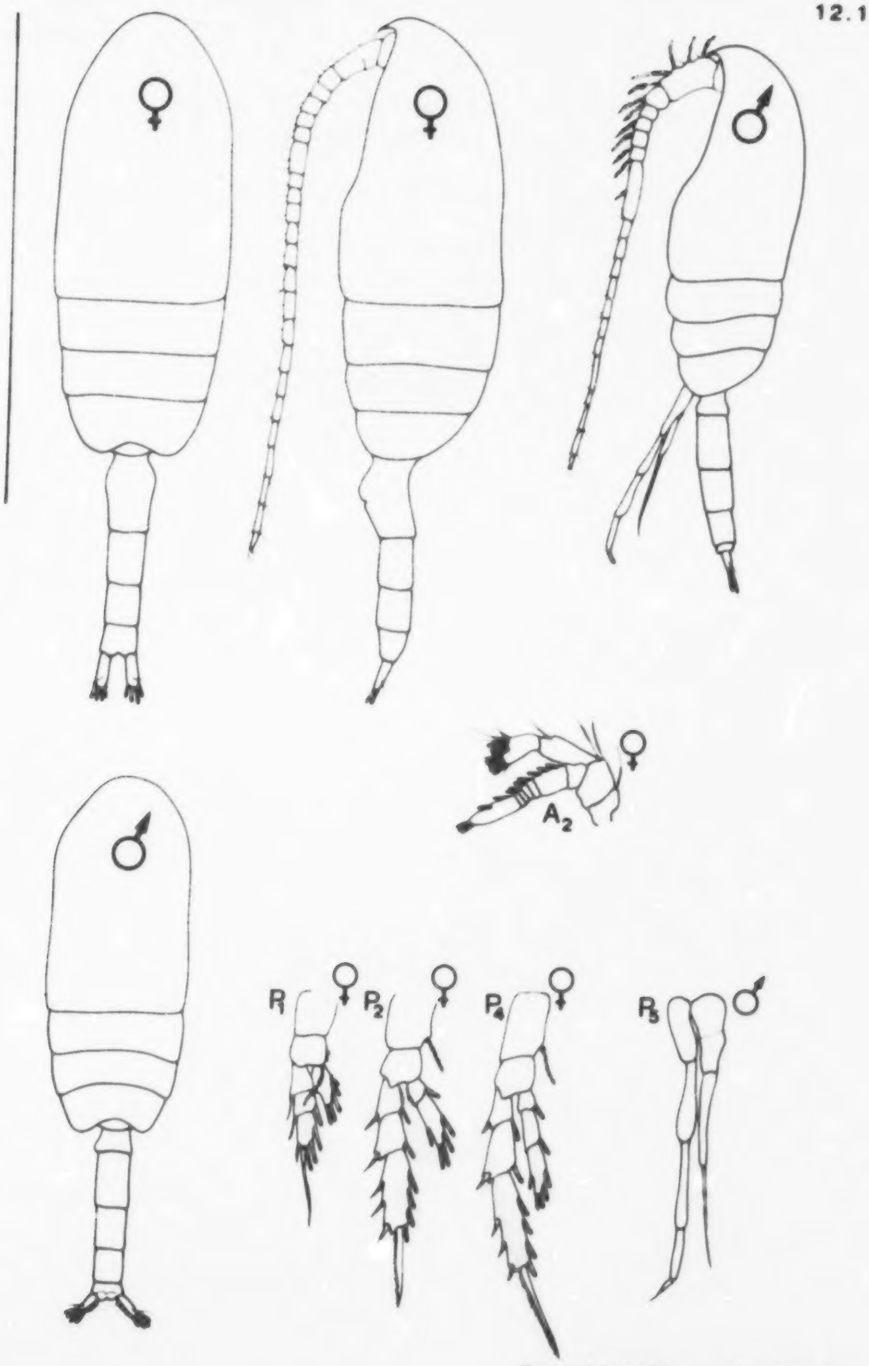
Comments:

Although abundant, cosmopolitan copepods, this genus is poorly known and a complete revision is required (1). Until then, the local form cannot be unambiguously referred to a given species (or group of species). The authors follow the example of With (5), Frolander (6), and Fulton (2) in calling the local species *P. minutus*. The most complete set of illustrations are those done by Sars (7) of *P. elongatus* and have been used in Fig. 12.1.1.

References:

1) Corkett and McLaren, 1978
2) Fulton, 1972
3) Davis, 1949b
4) Cameron, 1957
5) With, 1915
6) Frolander, 1962
7) Sars, 1903

12.1.1



♀
♀
♂
♀
A_2
♂
P_1 ♀
P_2 ♀
P_4 ♀
P_5 ♂

Pseudocalanus cf. minutus

from Sars,1903

12.2 Microcalanus Sars, 1901

Morphology:

Small, stocky Pro; two rostral filaments; CR short with four terminal setae. P1 exp1 lacking spine, P1 enp with four setae (1).

FEMALE Ur short, four-segmented; P5 absent (1).

MALE P5 uniramous; lft leg six-jointed, with distal joint round; rt P5 three-jointed and very short (1).

	Microcalanus	Pseudocalanus	Scolecithricella or Clausocalanus	Paracalanus
mP5 very short on one side	y	n	n	n
fP5 present	n	n	y	y
Number of P1enp setae	4	5	5	5
P1,2 segmentation	3-1/3-2	3-1/3-2	3-1/3-2	3-2/3-3
P1 exp1 with outer edge spine	n	y	+	y
P2, with surface spination	n	n	+	y

References:

1) Brodsky, 1950

12.2.1 *Microcalanus pygmaeus pusillus* Sars, 1903

Synonymy:

Microcalanus pusillus: Sars (1903); Campbell (1929b); Brodsky (1950); Legare (1957); Fulton (1968)

Morphology:

Ro of two filaments; PLC rounded or produced as short, round processes; A1 just less than TL; CR short; P1 expl lacking outer spine, P1 enp with four setae (1).

FEMALE TL 0.7-0.9 mm; P5 lacking; P2-P4 exp3 with serrate apical spines (1).

MALE TL 0.7-0.8mm; P5 asymmetrical; rt P5 three-segmented; lft P5 six-segmented, twice length of rt P5 (1).

Distribution and Occurrence:

Widespread in cold water. Reported from the North Atlantic and North Pacific Oceans and Antarctic region (1, 2). Locally, recorded as abundant in surface waters of the Strait of Georgia (3).

Life History:

The juvenile copepodites have not been described; however, the naupliar stages have been described briefly and sizes reported (3).

Total Length (mm):

NVI	0.21	NIII	0.13
NV	0.18	NII	0.09
NIV	0.16	NI	0.08

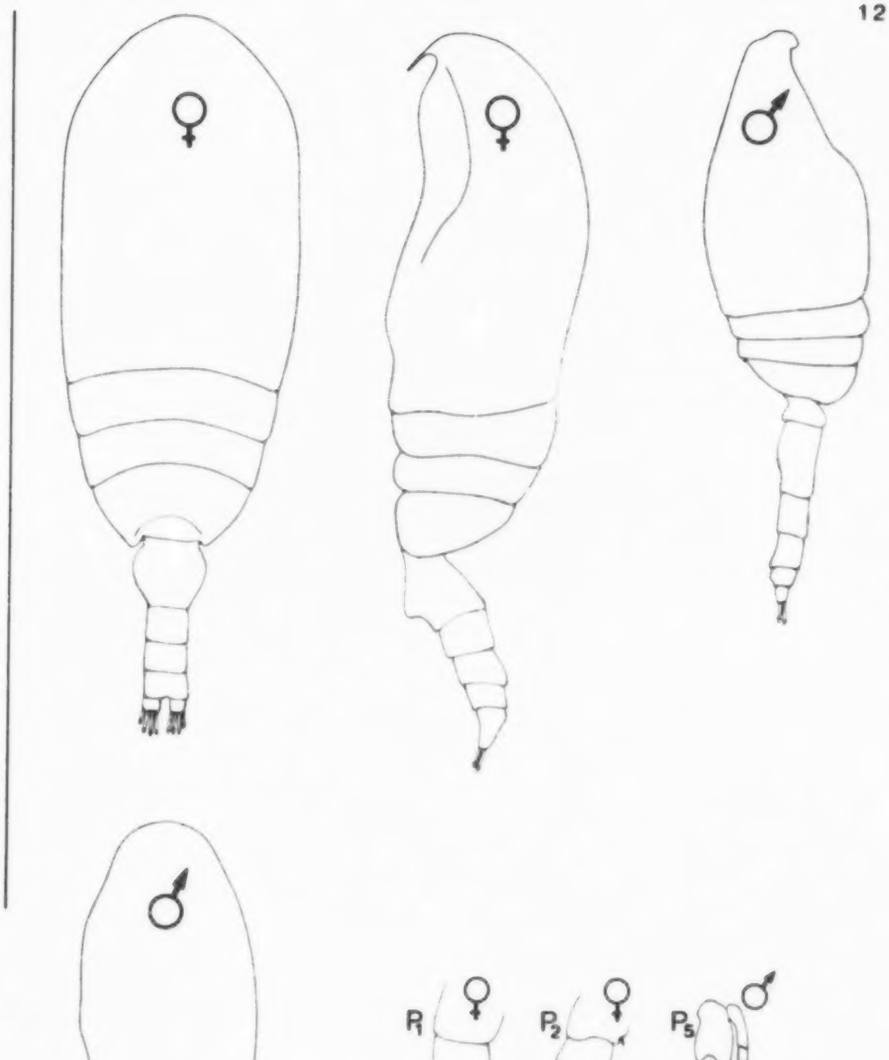
Comments:

Sars described two species of *Microcalanus*: *M. pusillus* (4) and *M. pygmaeus* (as *Pseudocalanus pygmaeus*: 5). The differences between these species are minor. *M. pygmaeus* has finely toothed apical spines on the P2-P4 exp, versus coarsely toothed apical spines for *M. pusillus*. Right mP5 of *M. pygmaeus* is approximately 0.5 x lft mP5. In *M. pusillus*, rt mP5 is approximately 0.33 x lft mP5. However, intermediate forms occur, and Farran and Vervoort (6) adopt the view that the two forms are sub-specific varieties of *M. pygmaeus*. We follow that viewpoint, but further taxonomic work should be done on the species.

References:

1) Brodsky, 1950
2) Tanaka, 1956b
3) Fulton, 1972
4) Sars, 1903
5) Sars, 1900
6) Farran and Vervoort, 1951e

12.2.1



Microcalanus pygmaeus pusillus

from Brodsky, 1950; Tanaka, 1956

12.3 Clausocalanus Giesbrecht, 1888

Morphology:

Small copepod with a TL less than 2.0 mm; Hd and PLC rounded; thorax three-segmented. A1 equal to or less than Pro length. CR with short medial setae originating from dorsal surface; lateral-most caudal seta reduced to a short spine; two apical and two subapical caudal setae. A2 exp 1½ x longer than enp. Exp-enp segmentation of P1 through P4: 3-1/3-2/3-3/3-3. P2,3 bp2 broadening distally to about 1½ x as wide as proximal margin; postero-distal margin of P2, P3 bp2 with three or more spiniform processes (1).

FEMALE Ur four-segmented; Ro of two short, rigid spiniform processes. P5 uniramous, three-segmented, essentially symmetrical, 3P5 with terminal bifid process (1).

MALE Ur five-segmented, ansgt reduced; Ro reduced to a single median, ventrally protruding knob or not well developed. P5 uniramous, asymmetrical; long leg somewhat styliform, five-segmented, terminal segment short, first segment more than twice as long as shorter leg (1).

	Clausocalanus	Microcalanus	Pseudocalanus	Paracalanus or Scolecithricella
mP5 very short on one side	y	y	n	n
fP5 present	y	n	n	y
Number of P1enp setae	5	4	5	5
P1 exp1 with outer edge spine	n	n	y	+
P2 with surface spination	n	n	n	y

Comments:

This genus has been completely revised (1).

References:

1) Frost and Fleminger, 1968

12.3.1 Clausocalanus arcuicornis (Dana, 1849)

Synonymy:

Calanus arcuicornis: Dana (1849)
Clausocalanus arcuicornis forma major: Tanaka (1956b)

Morphology:

Pro fusiform; Hd and PLC rounded; A1 short (1).

FEMALE TL 0.9-1.3 mm; Ur shorter than 1/3 Pro; Ro in lateral view short, thick at base, usually straight or slightly curved; ventral margin of gnsgt only slightly protruding, gnsgt more than 1.5 x Ur3; gnsgt dorsal lobe elongate, arising from anterior edge of ventral lobe; P5 uniramous, 3P5 at least twice length of 1P5 (1).

MALE TL 1.0-1.6 mm; Ur longer than 1/3 Pro; Hd rounded, may appear flattened anteriorly; Ro in lateral view knoblike and protruding ventrally; P5 uniramous; lft P5 longer than Ur, rt P5 reduced to small three-segmented knob; seminal vesicle extends within Pro to a point anterior to the point of attachment of the P1 (1).

Separable from other members of the genus found locally by the point of origin of the dorsal lobe of the gnsgt (arises from anterior edge of ventral lobe) and the relative length of the m Pro (less than 5.7 x as long as Ur2).

Distribution and Occurrence:

Some distributional records may be suspect in light of a recent revision of the genus (1); nevertheless, the species appears to be widespread in tropical and subtropical regions. Rare locally, with a single record from samples in the Institute of Ocean Sciences collection.

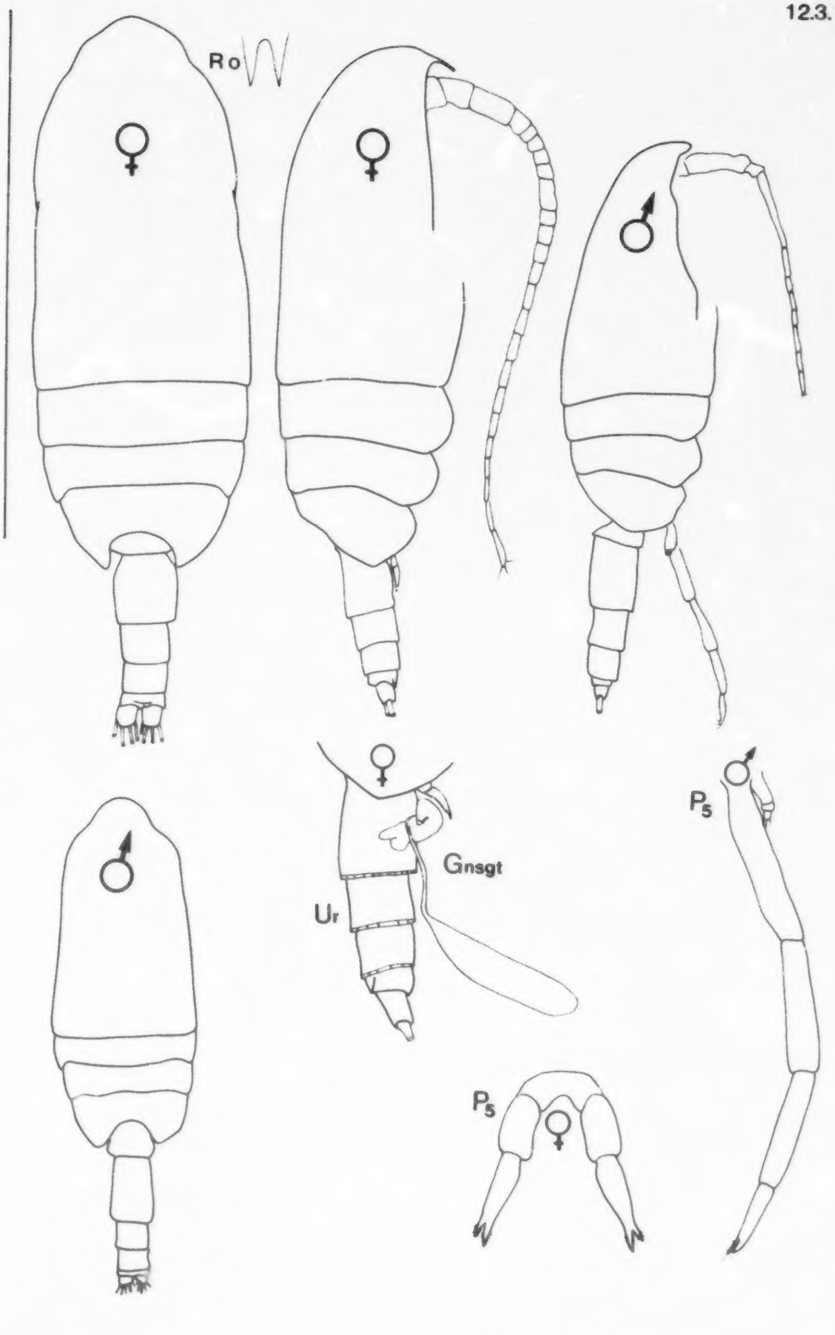
Life History:

Juveniles undescribed, key valid for adults only.

References:

1) Frost and Fleminger, 1968

12.3.1


Ro
♀
♀
♂
♂
♀
Gnsgt
Ur
♂
P5
P5
♀

Clausocalanus arcuicornis

from Frost and Fleminger, 1968

12.3.2 Clausocalanus lividus Frost and Fleminger, 1968

Synonymy:

Clausocalanus arcuicornis: Fleminger (1964)

Morphology:

Hd, PLC rounded; A1 short; three thoracic segments; P3 bp2 with three prominent spiniform processes along posterior distal margin (1).

FEMALE TL 1.26-1.77 mm; Ur shorter than 1/3 Pro; Ro in lateral view long, thick, usually straight, tapered uniformly; gnsgt not protuberant ventrally, and 1.5 x Ur3; gnsgt ventral lobe large in lateral view, with some portion usually anterior to origin of dorsal lobe; dorsal lobe thick, extending towards dorsal margin of gnsgt; 3P5 less than 2.0 x 1P5 (1).

MALE TL 1.13-1.45 mm; Ur longer than 1/3 Pro; Ro in lateral view knoblike and protruding ventrally; lft P5 longer than Ur; rt P5 reduced; Ur2 longer than 1.35 x 2P5; seminal vesicle does not extend as far as point of attachment of P1 (1).

Separable from other local members of the genus by the relative length of the f 3P5 (less than 2.0 x 1P5) and the m Ur2 (longer than 1.35 x 2P5).

Distribution and Occurrence:

Subtropical, circumglobal, apparently biantitropical in the Pacific (1). Locally, rare, but reported from the Strait of Juan de Fuca (2).

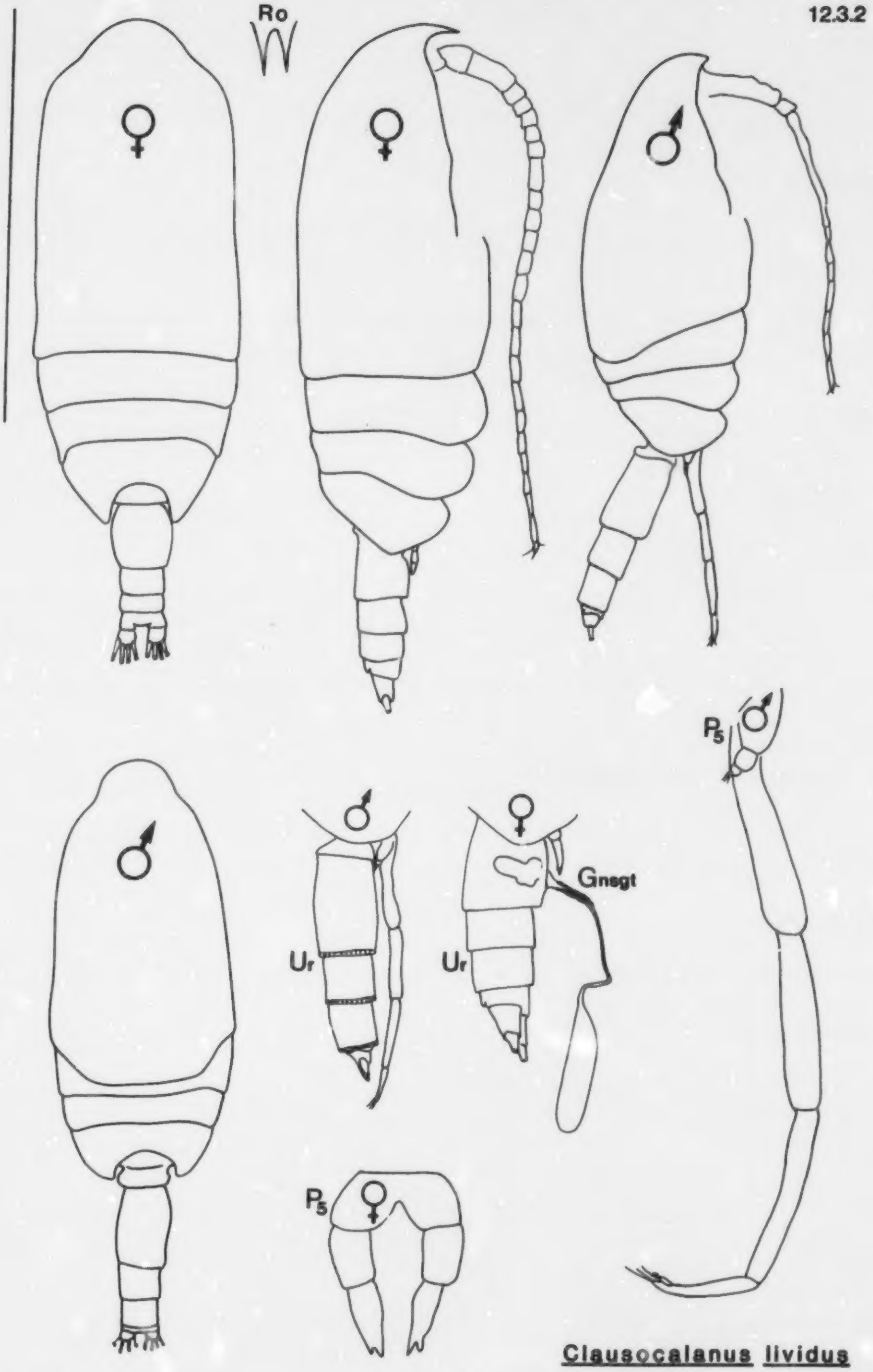
Life History:

Juveniles undescribed, key valid for adults only.

References:

1) Frost and Fleminger, 1968
2) Chester et al., 1980

12.3.2


Ro
♀
♀
♂
♂
♂
Ur
♀
Gnsgt
Ur
P5
♀
P5
♂

Clausocalanus lividus

from Frost and Fleminger, 1968

12.3.3 Clausocalanus parapergens Frost and Fleminger, 1968

Synonymy:

Clausocalanus arcuicornis: Esterly (1924)
C. pergens: Tanaka (1960); Fleminger (1964)

Morphology:

Hd, PLC rounded; P3 bp2 with three prominent spiniform processes along posterior distal margin (1).

FEMALE TL 0.97-1.38 mm; Ur less than 1/3 Pro; Ro in lateral view usually short, thick, curved posteriorly; gnsgt slightly swollen, ventral margin undulant; gnsgt longer than 1.5 x Ur3; in lateral view, gnsgt dorsal lobe bulb-shaped and arising posterior to anterior margin of ventral lobe; f 3P5 longer than 2.0 x lP5.

MALE TL 0.97-1.15 mm; Pro similar to C. arcuicornis; Ro in lateral view knoblike and protruding ventrally; seminal vesicle does not extend as far forward as point of attachment of P1 (1).

Separable from other local member of the genus by the relatively long f3P5 (longer than 2.0 x lP5), the point of origin of the gnsgt dorsal lobe (posterior to anterior margin of ventral lobe), the relative length of the mUr2 (less than 1.35 x 2P5) and the relative length of the mPro (greater than 5.7 x Ur2).

Distribution and Occurrence:

Widespread in tropical and subtropical areas (1). Locally, recorded from the Strait of Juan de Fuca (2).

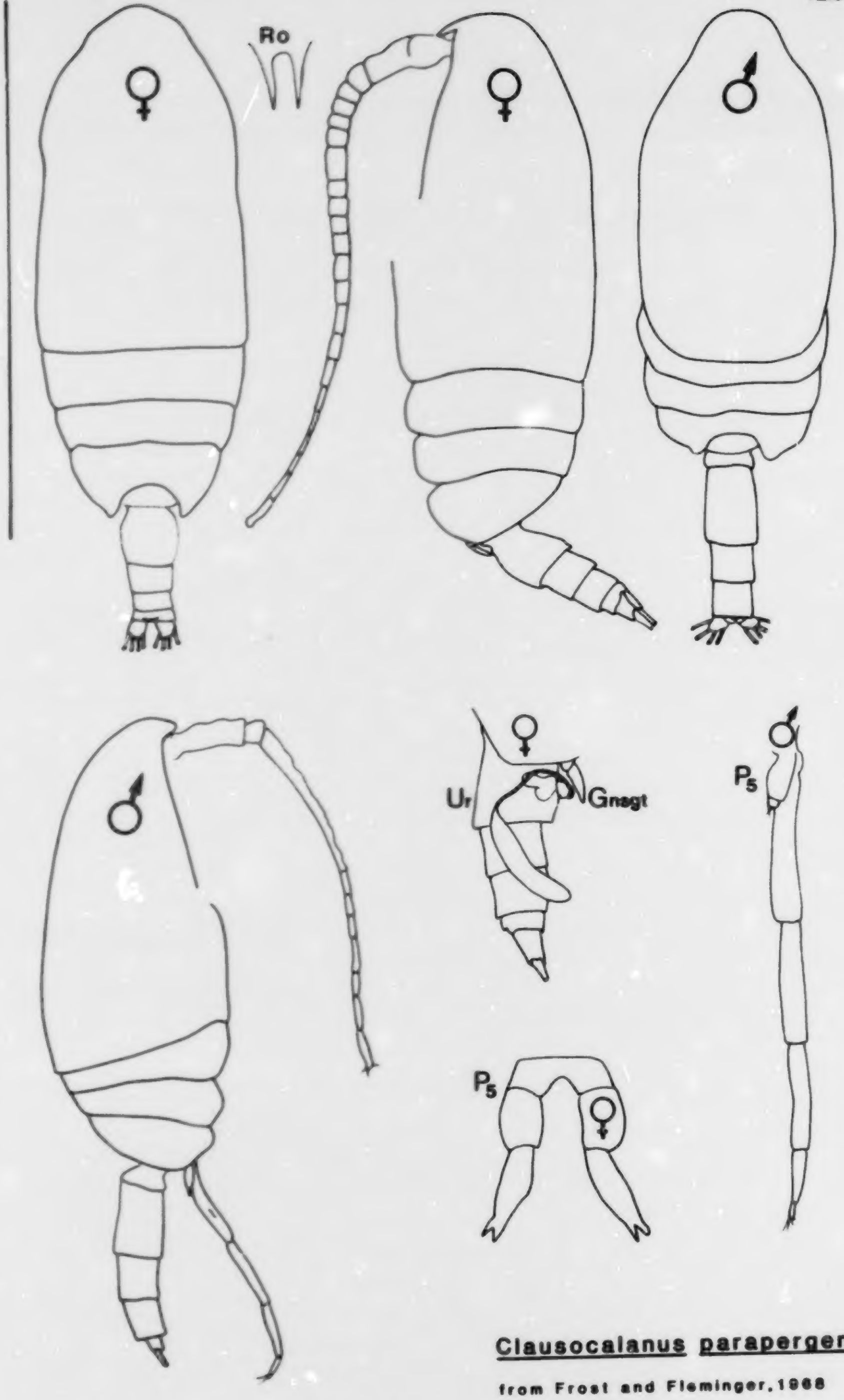
Life History:

Juveniles undescribed, key valid for adults only.

References:

1) Frost and Fleminger, 1968
2) Chester et al., 1980

12.3.3


♀
Ro
♀
♂
♂
♀
Ur
Gnsgt
♂
P5
P5
♀

Clausocalanus parapergens

from Frost and Fleminger, 1968

12.4 Ctenocalanus Giesbrecht, 1888

Morphology:

Small copepods with Calanus body type; A1 equal to total length or longer; Ro two long filaments. P3,4 exp3 deeply indented; P2,3 bp2 with smooth distal margin (1).

FEMALE P5 present on lft side only, three-segmented (1).

MALE P5 uniramous, lft side five-segmented, rt P5 almost totally atrophied, in form of small protuberance (1).

	Ctenocalanus	Clausocalanus or Microcalanus	Pseudocalanus	Paracalanus
mP5 very short on on side	n	y	y	n
fP5 present	y	y	n	n
P2 with surface spination	n	n	n	y
P1,2 segmentation	3-1/3-2	3-1/3-2	3-1/3-2	3-2/3-3
P1 exp1 with outer edge spine	?	n	y	y
P3,4 exp outer edge spines ctenate	y	n	n	n

References:

1) Brodsky, 1950

12.4.1 *Ctenocalanus vanus* Giesbrecht, 1888

Morphology:

Hd and PLC rounded; P2,3 exp3 deeply indented at point of attachment of outer edge spines; Ro of two thin filaments; CR short; A2 exp at least 1.5 x enp (1).

FEMALE TL 1.1-1.4 mm; A1 exceed TL; P5 present on lft side only, uniramous, reduced and three-segmented (1).

MALE TL 0.9-1.3 mm; P1exp lacking outer spines; A1 with thickened basal segments; P5 present on lft side only, uniramous, five-segmented; rt P5 occasionally present as small knob (1).

Distribution and Occurrence:

Extremely widespread; recorded from the Arctic, Atlantic, Pacific, and Indian Oceans (2). Locally, recorded from the Strait of Juan de Fuca (3).

Life History:

Juveniles undescribed, but the deeply indented spines on the P3 and P4 exp should be present, and diagnostic, in all copepodite stages older than the CIII.

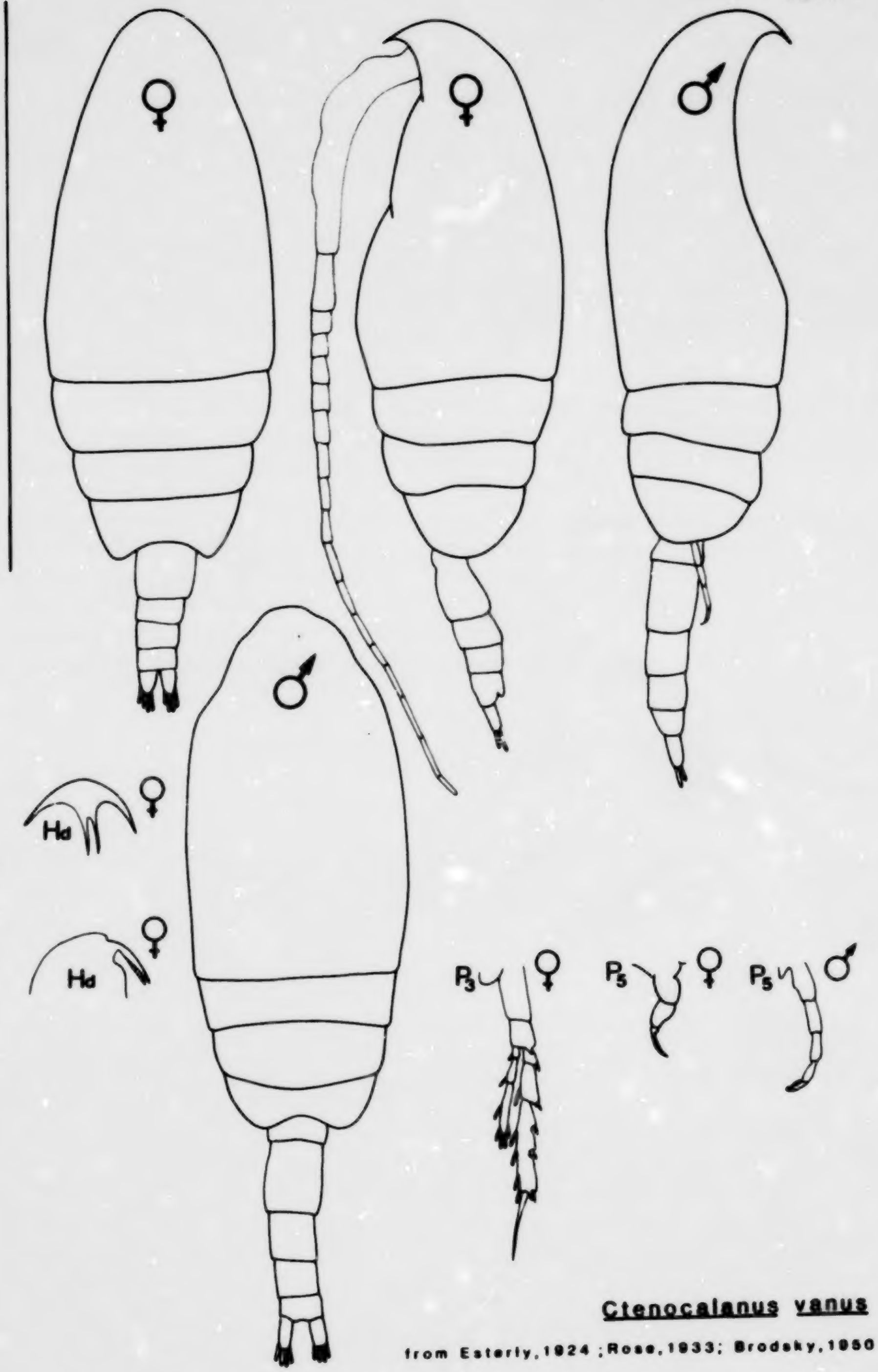
Comments:

Esterly's (4) species from the California coast does not conform completely with Giesbrecht's original description of *C. vanus*; however, Esterly concludes that the differences are not sufficient to erect a new species.

References:

1) Brodsky, 1950
2) Vervoort, 1963
3) Chester et al., 1980
4) Esterly, 1924

12.4.1


♀
♀
♂
♂
Hd
♀
Hd
♀
P_3
♀
P_5
♀
P_5
♂

Ctenocalanus vanus

from Esterly, 1924; Rose, 1933; Brodsky, 1950

13.1 Spinocalanus Giesbrecht, 1888

Morphology:

PLC and Hd rounded; Ro absent; A2 exp longer than A2 enp; CR and caudal setae sometimes asymmetrical. P1 exp1 with outer distal spine; P3,4 enp3 usually with two outer setae; posterior surface of P1-P4 may have rows of spines (1).

FEMALE A1 usually exceeding CR by 1-4 segments. P2-P4 exp2 distal anterior surface with one row of spinules; P2-P4 enp2 posterior surface with two rows of spines, one row sometimes reduced to small spinules. P4 bp1 with transverse row of setules; P5 absent (1).

MALE Armature of P1-P4 generally similar to corresponding female. P4 bp1 without transverse row of setules; P5 short, slender, biramous and usually asymmetrical (1).

The lack of a Ro and the rounded Hd and PLC separate this genus from all others in the area. Note, however, that the rostral area is difficult to see and must be carefully examined to ensure proper identification. Some earlier authors (2, 3) consider Spinocalanus to be a genus in the family Pseudocalanidae, but here we follow more recent precedence (1, 4) and place the genus within its own family, Spinocalanidae.

References:

1) Damkaer, 1975
2) Brodsky, 1950
3) Tanaka, 1956b
4) Farran and Vervoort, 1951g (Fiches, Sheet 39)

13.1.1 *Spinocalanus brevicaudatus* Brodsky, 1950

Synonymy:

Spinocalanus longicornis: Sars (1901)
S. abyssalis: Sars (1903); With (1915); Rose (1933); Tanaka (1937: male only); Davis (1949b); Farran and Vervoort (1951g: in part)
S. major: Esterly (1906)
S. pseudospinipes: Brodsky (1950)
S. similis var. *profundalis*: Brodsky (1955: female only)

Morphology:

Hd rounded in dorsal view; PLC rounded; PI expl with outer edge spine, exp3 posterior surface not spinose; Ro absent; P2 enp2 with one seta on outer margin; A2 expl with two setae (1).

FEMALE TL 1.4-2.4 mm; Pro:Ur ratio 3.0-4.0; gnsgt as long as wide, protruding ventrally; Al exceeds TL; P5 absent (1).

MALE TL 1.5-1.9 mm; Al reach Ur2; Pro:Ur ratio about 2.3; P5 biramous, lft side slightly more robust than rt; all rami tapering strongly towards apex, enp and exp subequal (1).

S. brevicaudatus is separable from other local members of the genus by the absence of spines on the posterior surface of the PI exp3 of the adult, and the presence of two setae on the A2 expl.

Distribution and Occurrence:

The species is widely distributed and has been reported from the North and Central Pacific, Indian and Atlantic Oceans and the Caribbean Sea (1). Locally, widespread in the study area, including the Strait of Juan de Fuca (2) and Strait of Georgia (3).

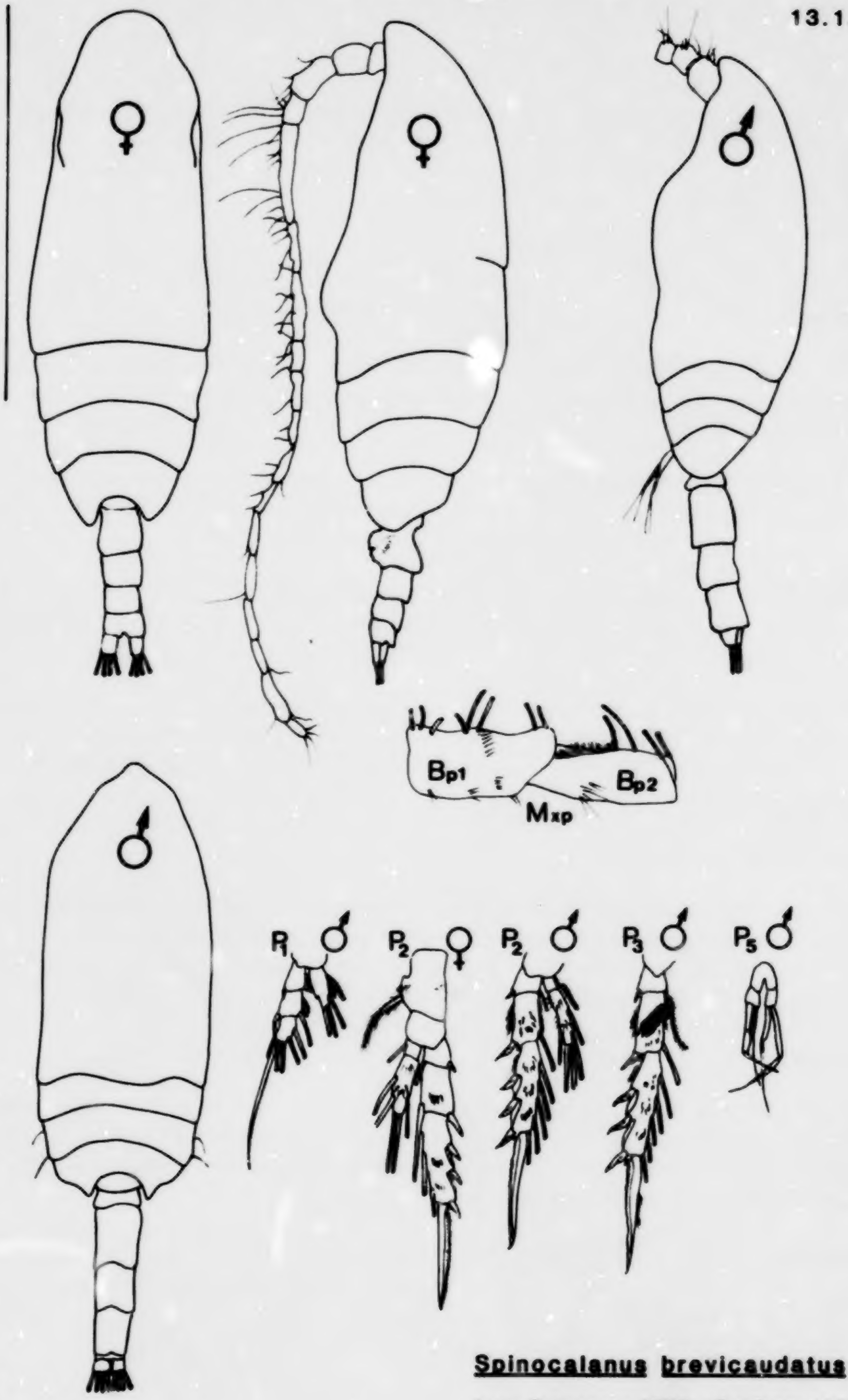
Life History:

The male CV has been briefly described (4). The remaining juvenile stages are undescribed, but the characters used in the key should allow partial identification of juveniles. Some confusion may arise with the juveniles of *S. horridus*, since the characters separating *S. brevicaudatus* and *S. horridus* are in part confined to the adult.

References:

1) Damkaer, 1975
2) Chester et al., 1980
3) Fulton, 1972
4) With, 1915

13.1.1


♀
♀
♂
Bp1
Bp2
Mxp
♂
P1 ♂
P2 ♀
P2 ♂
P3 ♂
P5 ♂

Spinocalanus brevicaudatus

from Semenova, 1962 ; Damkaer, 1975

13.1.2 Spinocalanus horridus Wolfenden, 1911

Synonymy:

Spinocalanus abyssalis: Tanaka (1937: in part); Minoda (1971: in part)
S. stellatus: Brodsky (1950); von Vaupel-Klein (1970)
S. spinipes: Brodsky (1950: female only)
S. dorsispinosus: Brodsky (1950)
S. longispinus: Brodsky (1950)
S. spinosus: Tanaka (1956b)

Morphology:

Hd, PLC rounded; Pl expl with outer edge spine; Ro absent; P2 enp2 with one seta on outer margin; A2 expl with two setae; Pl exp3 posterior surface spinulose (1).

FEMALE TL 1.95-3.00 mm; thoracic segments spinulose near lateral margins; Pro:Ur ratio about 2.7; gnsgt just longer than wide, protruding ventrally; A1 just exceeds TL (1).

MALE TL 2.0-2.9 mm; Pro:Ur ratio about 1.7; A1 reach end Pro; P5 biramous, exp longer than enp; rami elongate, tapering distally (1).

Separable from other local Spinocalanus by the presence of one seta on the outer edge of P2 enp2 and the presence of spines on the posterior surface of the Pl exp3 in the adult. May be difficult to separate from S. brevicaudatus in younger stages.

Distribution and Occurrence:

Widely distributed in cold waters. Reported from the Arctic, Pacific, and Atlantic Oceans and Antarctic region (1). Locally, rare but reported from the Strait of Juan de Fuca (2) and from the northeastern Pacific (3). A deep-living species not usually abundant inshore.

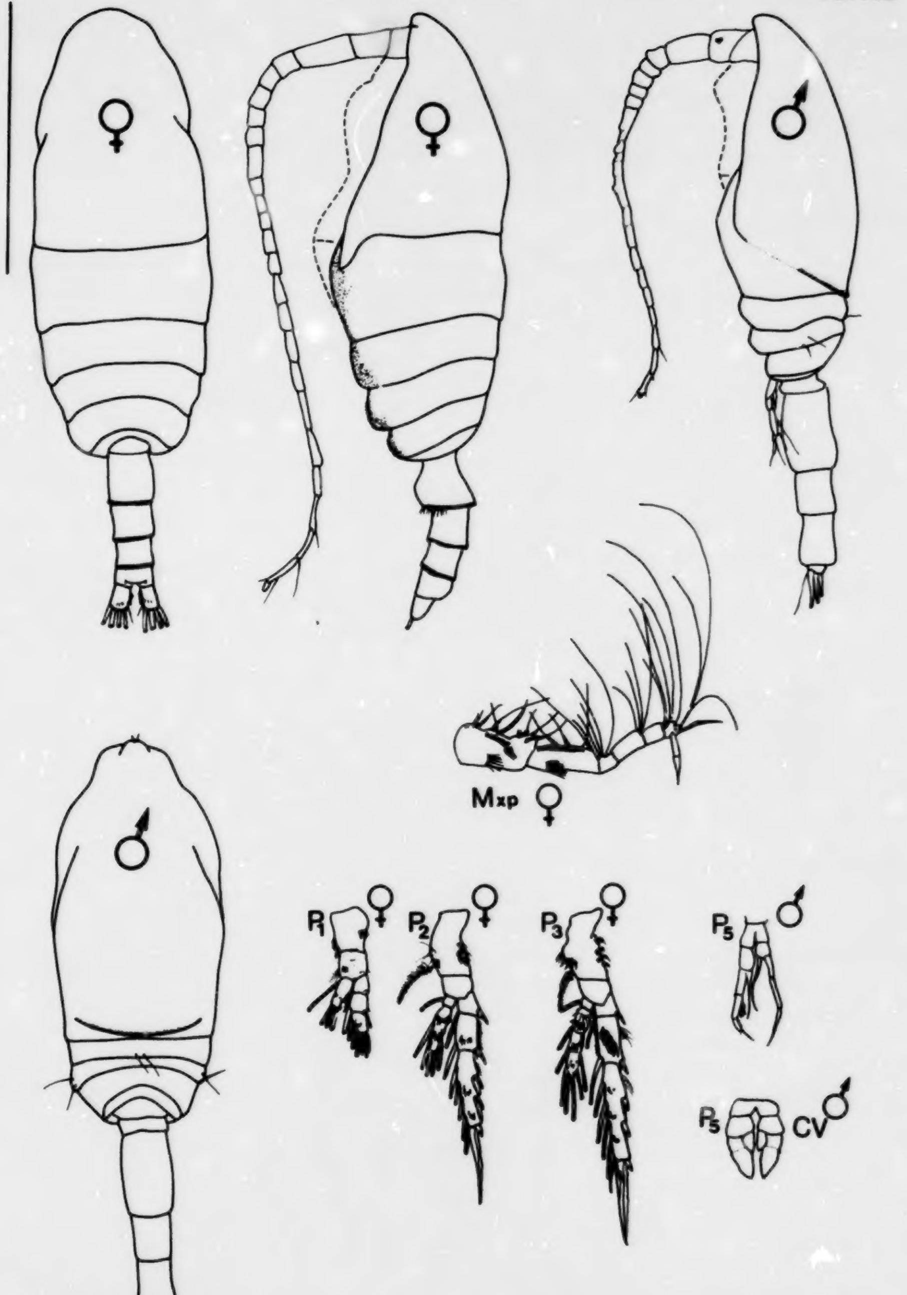
Life History:

The mP5 has been described for the CV. The rami are short and stout, with small apical spines. The length of the CV is reported as 1.95-1.97 mm from Arctic specimens (1). Other juveniles are undescribed. The characters used in the key are valid for the adults only.

References:

1) Damkaer, 1975
2) Chester et al., 1980
3) von Vaupel-Klein, 1970

13.1.2


♀
♀
♂
Mxp ♀
♂
P_1 ♀
P_2 ♀
P_3 ♀
P_5 ♂
P_5 CV♂

Spinocalanus horridus

from Damkaer, 1975

13.1.3 *Spinocalanus longicornis* Sars, 1900

Synonymy:

Spinocalanus schaudinni: Mrazek (1902); van Breemen (1908: in part)
S. abyssalis var. *pygmaeus*: Farran (1926)
S. parabyssalis: Park (1970: in part); Grice (1971)

Morphology:

Hd, PLC rounded; Plexpl with outer edge spine; P2 enp2 lacking setae on outer edge: A2 expl with one seta; posterior surface of Pl exp3 lacking spines (1).

FEMALE TL 0.88-1.30 mm; Pro:Ur ratio about 3.5; gnsgt slightly wider than long, protruding ventrally; A1 exceed TL (1).

MALE TL 1.0-1.4 mm; Pro:Ur ratio about 2.0; Al shorter than Pro; P5 biramous, reach distal margin of Ur2, exp longer than enp, enp reduced to a single segment, exp three-segmented; lft P5 slightly more robust than rt (1).

Separable from other local members of the genus by the lack of setae on the outer edge of P2 enp2 and the presence of only one seta on A2 expl.

Distribution and Occurrence:

Widely distributed, with records from the Arctic, Pacific and Atlantic Oceans, and the Mediterranean and Caribbean Seas (1). Locally, rare but recorded from the Strait of Juan de Fuca (2) and northeastern Pacific (3).

Life History:

The P5 of the CV male has been described. Both rami are short and stout, segmentation of the exp is incomplete and the enp is reduced. The CV TL is 0.88-0.95 mm (1). Other juvenile stages have not been described. The characters used in the key should allow identification of the CV and possibly CIV.

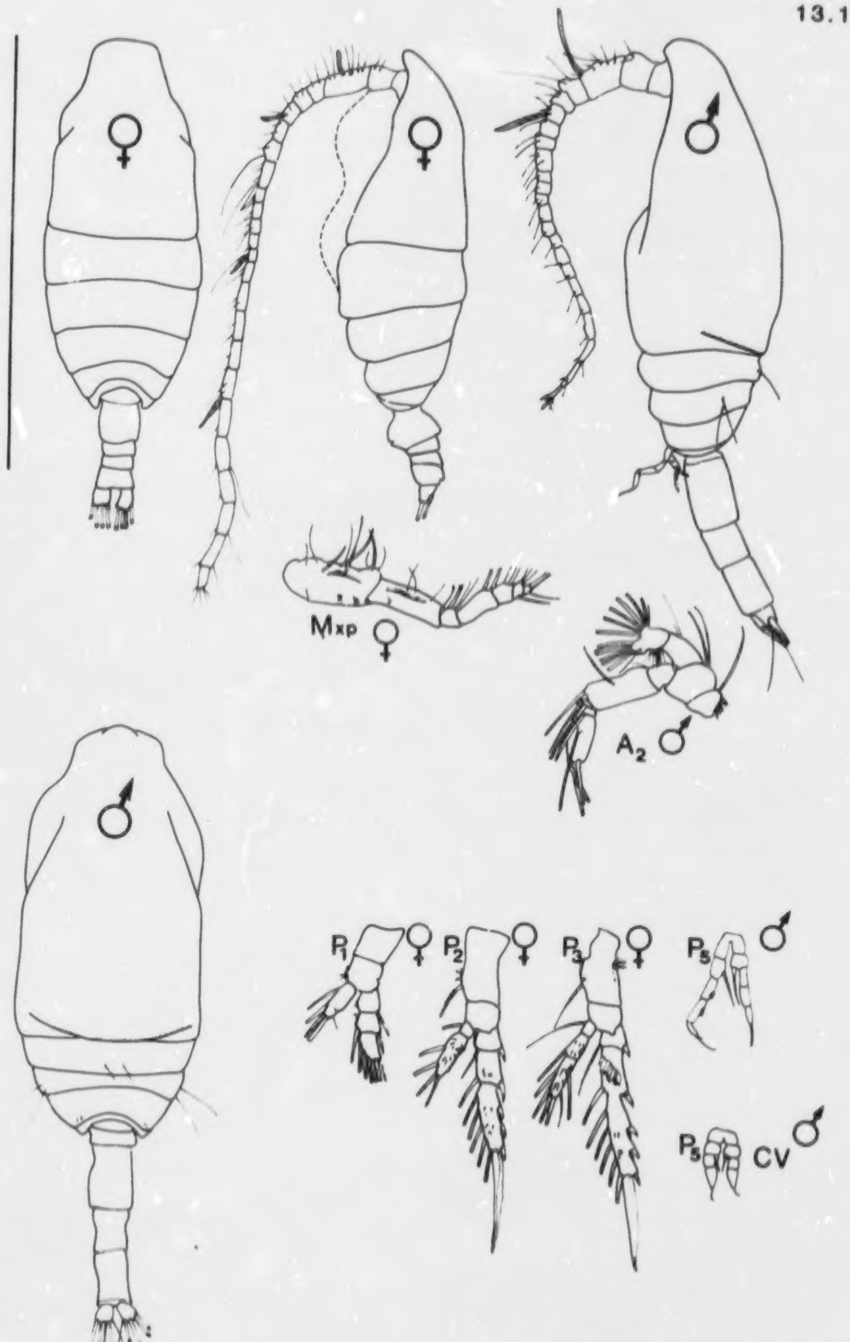
Comments:

This species may often be undersampled and/or overlooked due to its small size.

References:

1) Damkaer, 1975
2) Chester et al., 1980
3) von Vaupel-Klein, 1970

13.1.3


♀
♀
♂
Mxp ♀
A₂ ♂
♂
P₁ ♀
P₂ ♀
P₃ ♀
P₅ ♂
P₅ CV ♂

Spinocalanus longicornis

from Damkaer, 1975

14.1 Aetideus Brady, 1883

Morphology:

Hd vaulted; PLC with acute, backwardly directed points when viewed laterally (1).

FEMALE Ro strongly chitinised, two-pointed. A1 of 23 segments (8-9, 24-25 fused). P1,2 enp one-segmented, although fusion line may be visible in P2. P1 expl without outer edge spine. P4 bp1 with row of small spines at base of inner distal seta, P5 absent (1, 2).

MALE Ro absent; PLC reduced in length, same type as female. A1 of 21 segments (8-10, 12-13, 20-21 fused). P5 present on lft side only, uniramous, five-segmented, elongate (1, 2).

	Aetideus	Bradyidius	Chiridius	Azygokeras	Euchirella
A2 rami subequal	y	y	n	y	n
fRo	y	y	n	n	+
mRo	n	y	n	n	+
P1 expl spine	n	y	y	y	y
mP5	uniramous	biramous	uniramous	biramous	biramous
length ratio rt mP5:lft mP5	0:1	#	1:1.2	#	#

References:

1) Bradford, 1971a
2) Brodsky, 1950

14.1.1 *Aetideus divergens* Bradford, 1971

Synonymy:

Aetideus armatus: Campbell (1929b); Davis (1949b); Brodsky (1950); Cameron (1957); Legare (1957); Fulton (1972)

Morphology:

PLC with acute projections; A1 approximately equal to TL; P1 exp three-segmented; P2 enp one-segmented (1).

FEMALE TL 1.6-1.9 mm; Ro small, with two basally-separate, parallel filaments; PLC barely extend past distal margin gnsgt; PLC diverge outwards; dorsal and ventral lobes of gnsgt connected by long, thick tube (1).

MALE TL 1.25-1.43 mm; PLC extend well past Ur1; Ro absent; ansgt reduced; P5 present on lft side only (1).

Separable from *A. pacificus* by the smaller size and slightly divergent PLC.

Distribution and Occurrence:

The only confirmed record is from the northeastern Pacific (1); however, based on a possible synonymy with *A. armatus* from the San Juan Islands (2) the species appears to be widely distributed and common in the study area.

Life History:

Juveniles undescribed; however, the characters used to identify the species should allow identification of the CV.

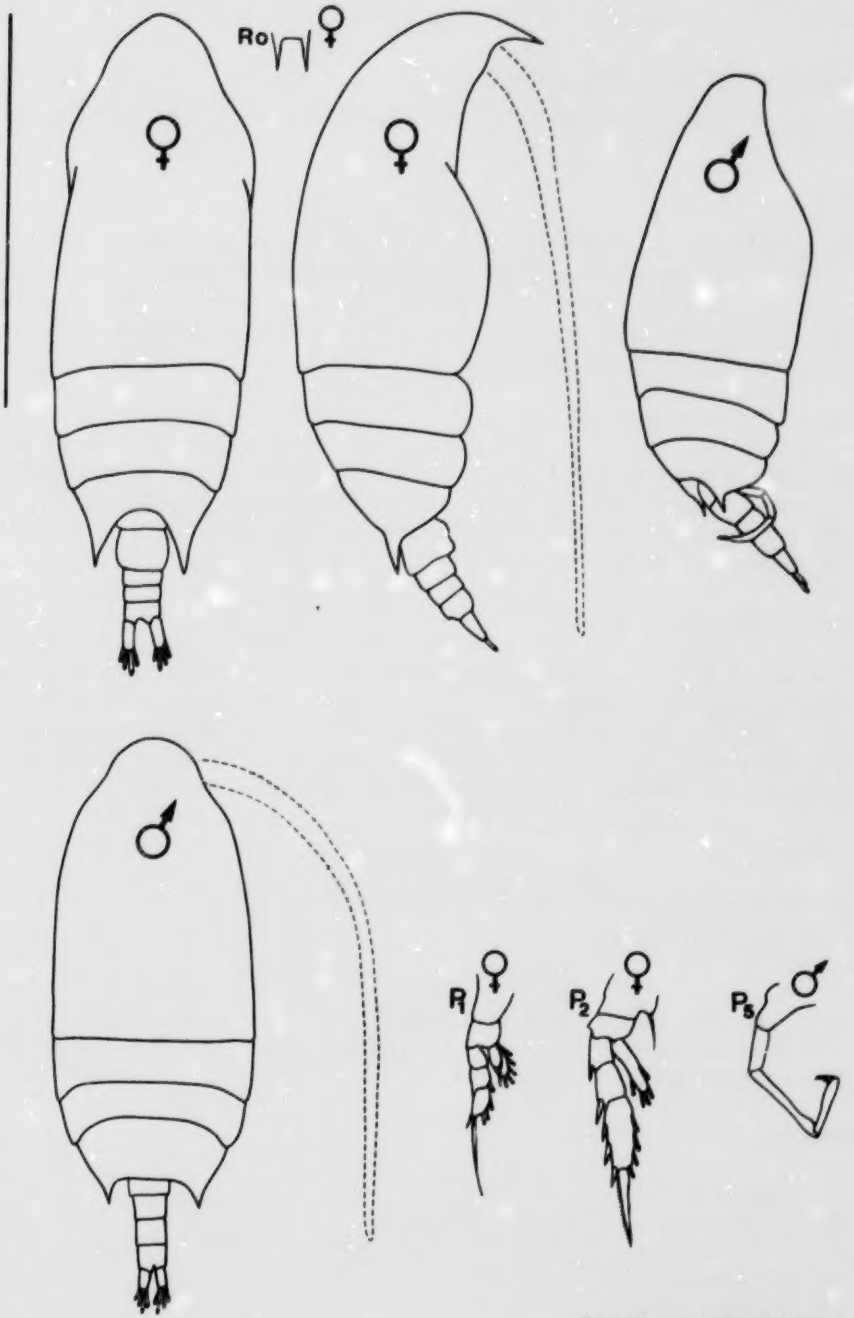
Comments:

Aetideus divergens was described as a new species from specimens taken in the northeastern Pacific Ocean (1). The type locality of the species is 52°02'N, 132°53'W, just outside of the present study area. Park (2) synonymizes *A. divergens* with *A. armatus* from the San Juan Islands, and it is likely that references to *A. armatus* refer instead to *A. divergens*.

References:

1) Bradford, 1971a
2) Park, pers. comm.

14.1.1



Aetideus divergens

from Tanaka,1957; Bradford,1971

14.1.2 Aetideus pacificus Brodsky, 1950

Synonymy:

Aetideus armatus (?): Esterly (1905)

Morphology:

FEMALE TL 2.2-3.0 mm; Pro:Ur ratio approximately 3.4; PLC acute, slightly convergent in dorsal view, PLC points do not reach distal margin gnsgt; Ro of two basally-separate, distally diverging filaments; A1 exceed TL; P1 exp three-segmented; P2 enp one-segmented; P5 lacking (1, 2).

MALE undescribed.

Separable from A. divergens by its larger size and the tendency of the PLC to curve toward the midline. A1 usually two segments beyond the CR. Segmentation of P1 and P2 rami may be partially obscured by fusion, and must be examined carefully.

Distribution and Occurrence:

Reported from the central and western North Pacific, Sea of Okhotsk and Bering Sea (1). Brodsky (1) suggests Esterly's (3) record of A. armatus from the California coast conforms with A. pacificus; however, Bradford (4) disagrees. Locally, reported as deep and rare in the Strait of Georgia (5) and also reported from the Strait of Juan de Fuca (6).

Life History:

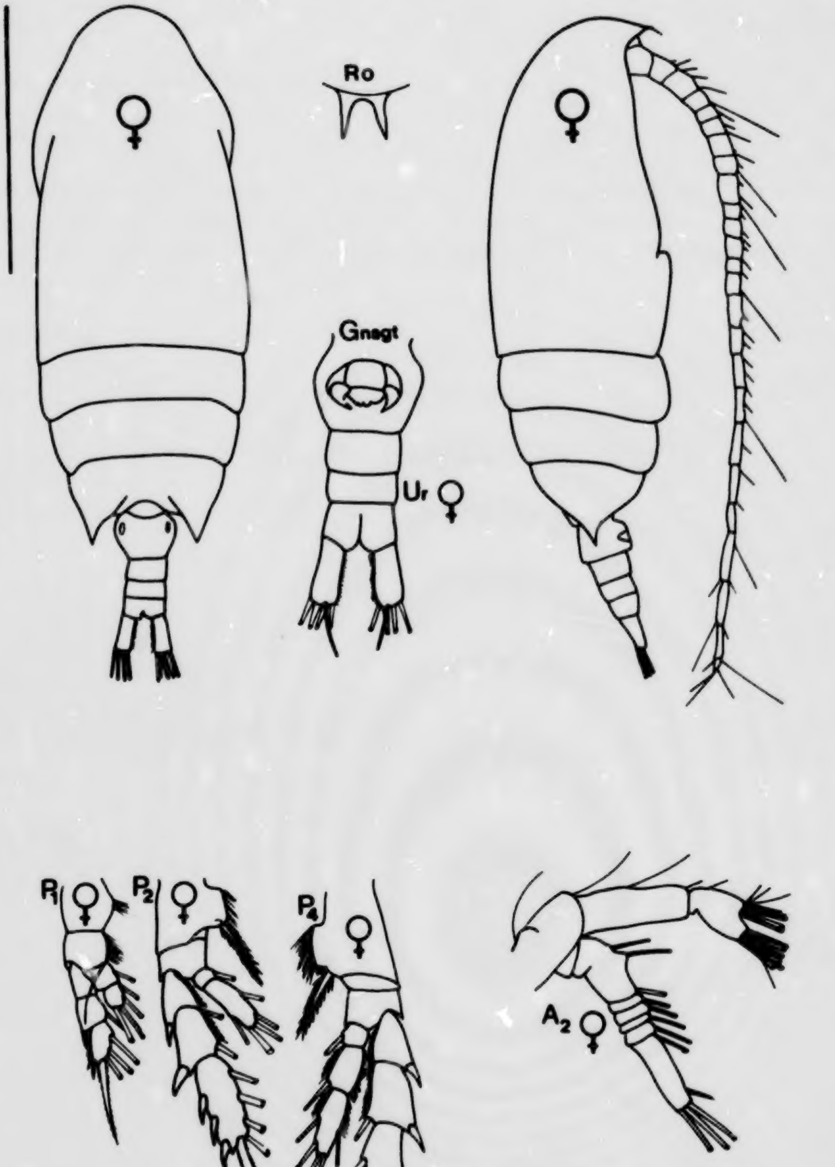
Juveniles undescribed, key valid for adults only.

Comments:

Although the species was originally described by Brodsky (1), his description was incomplete and Park's (2) revised description should be consulted. The species requires further taxonomic study to confirm its status.

References:

1) Brodsky, 1950
2) Park, 1968
3) Esterly, 1905
4) Bradford, 1971a
5) Fulton, 1972
6) Chester et al., 1980


♀
Ro
♀
Gnsgt
Ur ♀
P1 ♀
P2 ♀
P4 ♀
A2 ♀

Aetideus pacificus

from Park, 1968

14.2 Bradyidius Giesbrecht, 1897

Synonymy:

Undinopsis: Sars 1884

Morphology:

PLC terminating in acute points; bifurcate Ro; short Ur. A1 shorter than TL; A2 rami subequal. P1 expl with spine at outer distal corner; P2-P4 exp terminal spines with fine, widely spaced teeth. Posterior surface of P2-P4 enp usually with spinules (1).

FEMALE P5 absent (1).

MALE P5 uniramous, subequal (1).

	Bradyidius	Gaidius	Aetideus
P1 expl spine	y	+	n
fRo	bifid	single	bifid
mRo	bifid	single	absent

References:

1) Bradford and Jillett, 1980

14.2.1 Bradyidius saanichi Park, 1966

Morphology:

PLC acute, Hd rounded; A1 short, terminating near end of Pro; A2 exp longer than enp; CR relatively short; P1 exp1 with outer distal seta; three thoracic segments (1).

FEMALE TL 2.33-2.56 mm; Pro:Ur ratio approximately 3.4; Ro with two strongly divergent rami; PLC extensions strong, directed postero-dorsally and ending near distal margin of gnsgt; P5 lacking (1).

MALE TL 2.01-2.24 mm; Pro:Ur ratio about 2.4; PLC slightly curved downward and thus directed more posteriorly than in female, points smaller; P5 biramous, asymmetrical; P5 enp reduced to a single long, thin segment; rt P5 exp two-segmented, lft exp three-segmented (1).

B. saanichi is similar to but smaller than B. similis, and the PLC reach the distal margin of the female gnsgt versus the midpoint in B. similis. Note also that B. similis is rare in the study area; there has been only one, unconfirmed, report of its presence (2).

Distribution and Occurrence:

Not recorded outside the area covered by this manual. Fulton (3) records the species as common in Saanich Inlet, the type locality, but rare in the Strait of Georgia. Also reported from the Strait of Juan de Fuca (4).

Life History:

Juveniles undescribed; however, the CV and possibly CIV should be separable based on the characters used herein. Note that all copepodite stages of B. similis have been described (5) (see page 15).

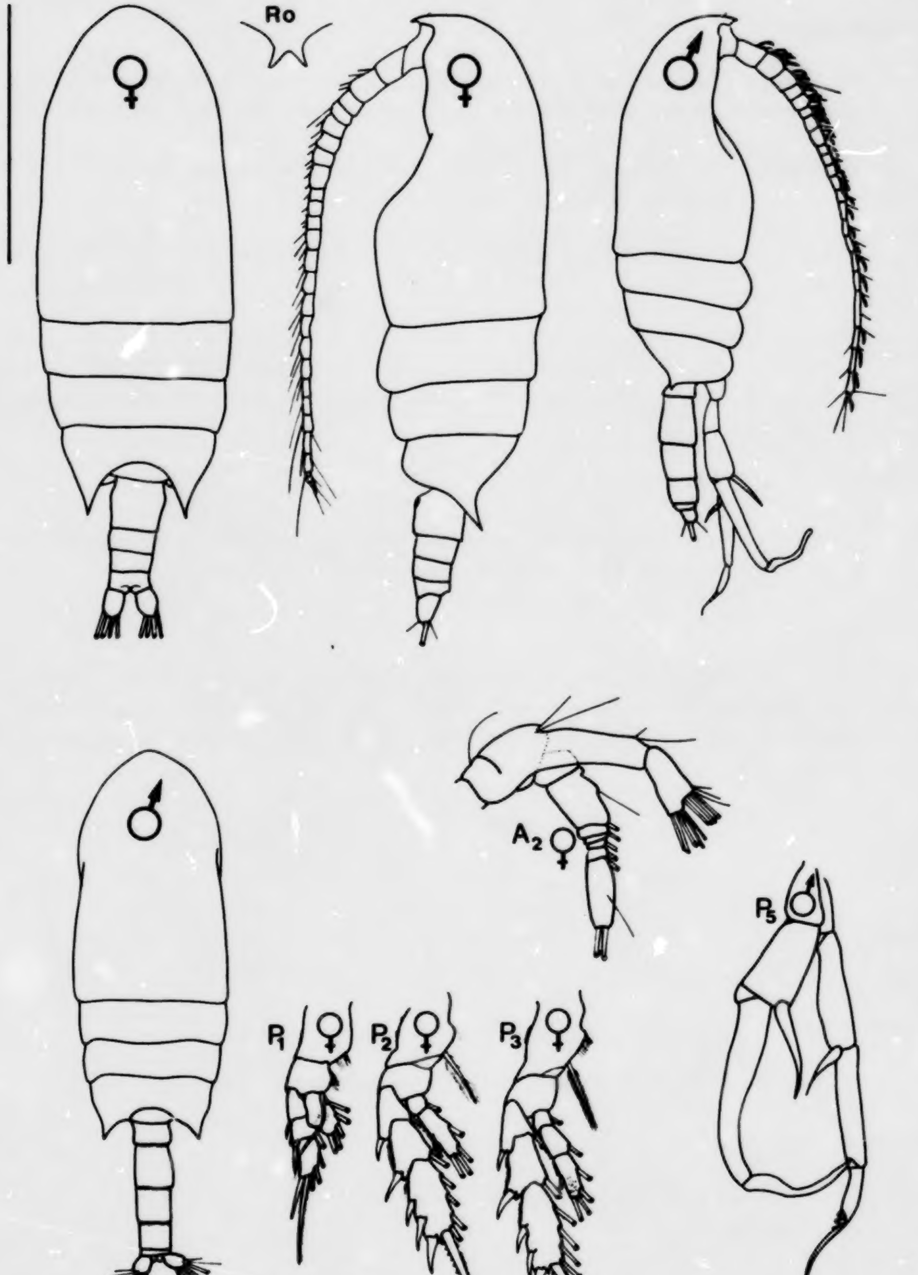
Comments:

One of the few species apparently endemic to the study area.

References:

1) Park, 1966a
2) Cameron, 1957
3) Fulton, 1972
4) Chester et al., 1980
5) Shih et al., 1981

14.2.1



♀
Ro
♀
♂
♂
A2 ♀
P1 ♀
P2 ♀
P3 ♀
P5 ♂

Bradyidius saanichi

from Park, 1966

14.2.2 Bradyidius similis (Sars, 1903)

Morphology:

PLC extended acutely; Hd rounded in dorsal view; A1 short; A2exp longer than enp; P1exp1 with outer distal spine; three thoracic segments (1).

FEMALE TL 2.7-3.0 mm; PLC reach midpoint of gnsgt; Ro with two slightly divergent rami (1, 2).

MALE TL 2.4-2.9 mm; PLC acute, but reduced compared to female; P5 biramous, enp reduced to a single, elongate segment; rt exp longer than lft (1, 2).

Similar to, but distinguishable from B. saanichi by the larger size and the length of the PLC (reach only midpoint of gnsgt vs distal edge for B. saanichi).

Distribution and Occurrence:

Arctic Ocean and North Atlantic Ocean, Bering and Okhotsk Seas (2). Locally, only one, unconfirmed report (3).

Life History:

All copepodite stages are fully described and are illustrated on page 15 (2). CV and CIV stages are identifiable using the characters described herein; however, they may be confused with B. saanichi juveniles, especially in the CIV.

Total Length (mm):

fCV	2.24-2.64	CIII	1.57-1.75
mCV	2.14-2.60	CII	1.00-1.42
fCIV	1.86-2.06	CI	0.74-0.80
mCIV	1.78-2.04		

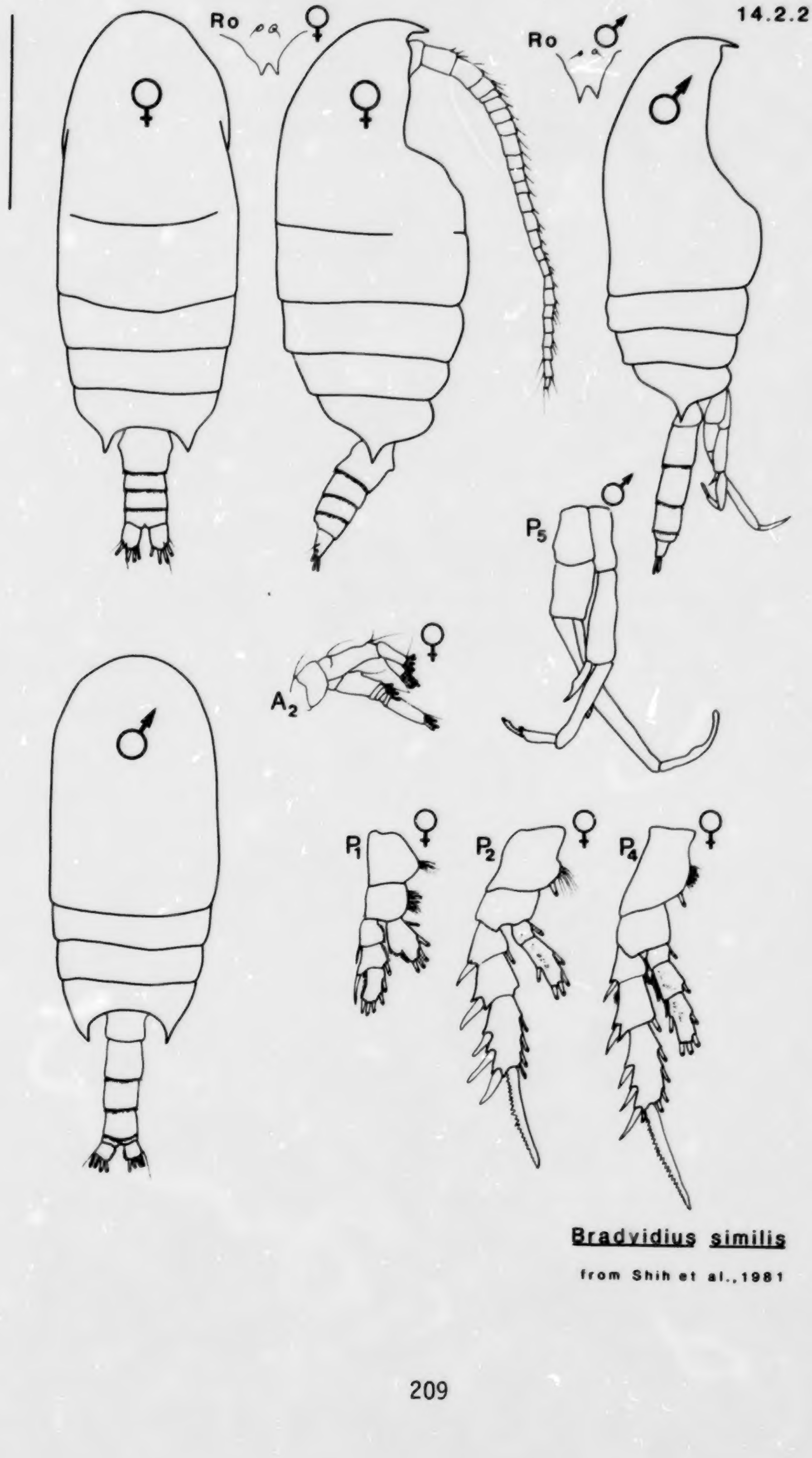
Comments:

It is unlikely that this species is found in the study area.

References:

1) Vervoort, 1952c (Fiches, Sheet 43)
2) Shih et al., 1981
3) Cameron, 1957

14.2.2


Ro
♀
♀
♀
Ro
♂
♂
♂
P5
♀
A2
♂
P1
♀
P2
♀
P4
♀

Bradyidius similis

from Shih et al., 1981

14.3 Chiridius Giesbrecht, 1892

Morphology:

PLC with acute points; Ro absent. A1 equal to or shorter than gnsgt. P1 expl with distal outer edge spine; P1,2 segmentation: 3-1/3-1 or 3-2; P2-P4 exp terminal spine with 22-28 strong spines along exterior margin (1,2).

FEMALE P5 absent (1, 2).

MALE P5 uniramous, styliform, 4 or 5 segments. Mouth parts reduced (1, 2).

	Chiridius	Aetideus	Bradyidius	Azgokeras	Euchirella
A2 rami subequal	n	y	y	y	n
fRo	n	y	y	n	+
mRo	n	n	y	n	+
P1 expl spine	y	n	y	y	y
mP5	uniramous.	uniramous	biramous	biramous	biramous
length ratio, rt mP5:lft mP5	1:1.2	0:1	#	#	#

References:

1) Brodksy, 1950
2) Vervoort, 1952d (Fiches, Sheet 44)

14.3.1 Chiridius gracilis Farran, 1908

Morphology:

Hd rounded, PLC acute; Ro absent; A1 approximately equals Pro length; A2 exp twice enp (1, 2)

FEMALE TL 2.4-3.1 mm; (Fulton (3) lists 4.8 mm as an upper size limit); Pro:Ur ratio about 3.0; PLC extend beyond midpoint of gnsgt; gnsgt symmetrical in dorsal view, about as long as wide; P1 expl with outer distal spine (1)

MALE TL 2.33-2.57 mm; Pro:Ur ratio about 3.4, Pro with lateral bulges at level of insertion of A2; PLC bend slightly inward and reach posterior margin of Ur1;P5 uniramous, rt and lft sides elongate; rt mP5 four segmented, distal segment falciform; lft mP5 five segmented, shorter than lft (2)

Separable from the larger but otherwise similar female of C. polaris by lack of segmentation in the P2 enp.

Distribution and Occurrence:

A deep water copepod found in temperate to tropical waters of all oceans (1). Locally, widespread. Common in the Strait of Georgia and throughout the study area in relatively protected waters (3). Rare in Queen Charlotte Sound and Hecate Strait (4).

Life History:

All copepodite stages have been well described (2). Note that the CI-CIII do not have acute PLC. Older stages may be identified to genus by the key, and C. gracilis can be separated from C. polaris in the female (CV and CVI). Stages older than CIII can be sexed by the presence of a P5 in the male.

Total Length (mm):

fCV	2.09-2.33	fCIV	1.50-1.72	CIII	1.16-1.28
mCV	2.04-2.46	mCIV	1.55-1.77	CII	0.85-0.92
				CI	0.56-0.60

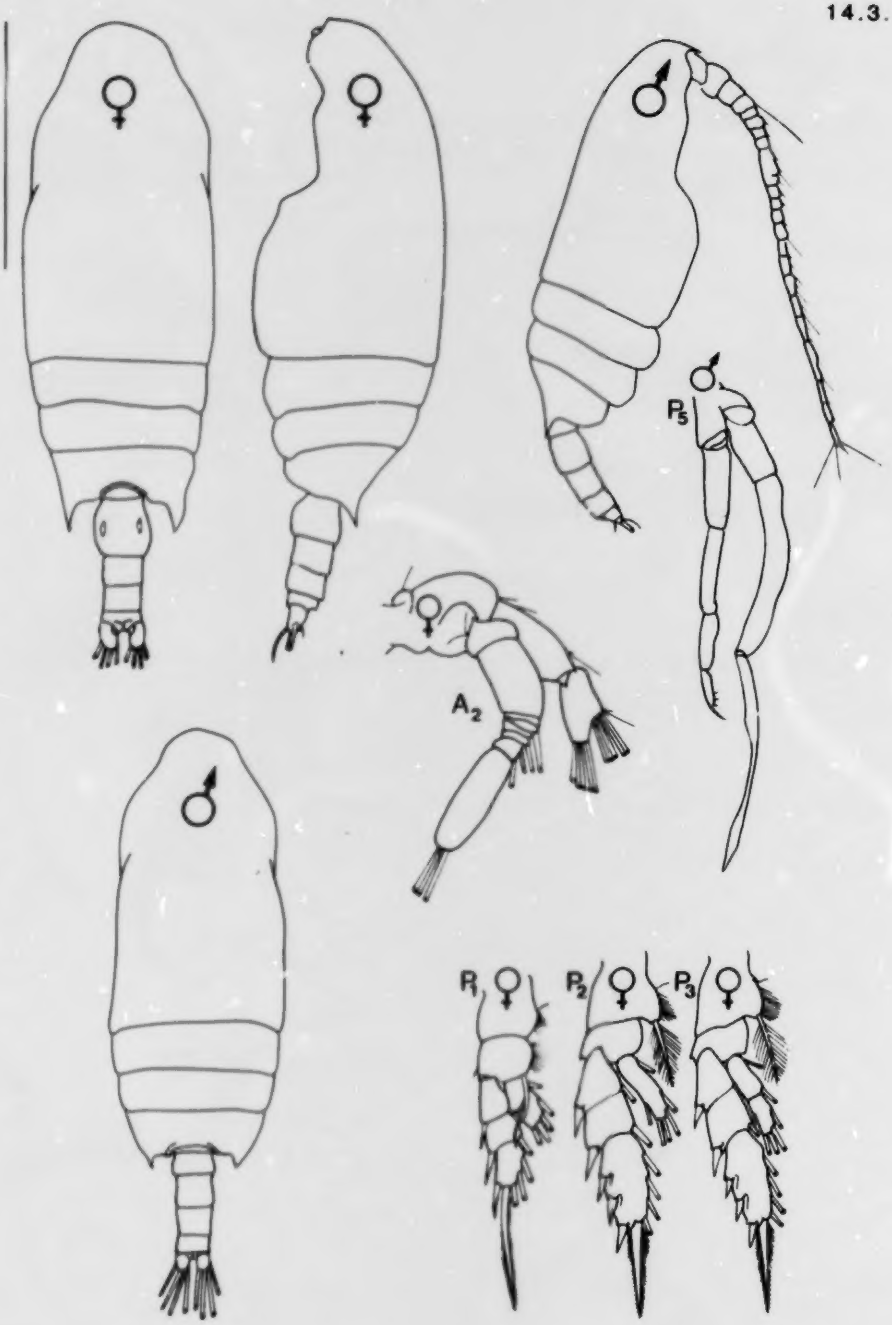
Comments:

Much more common than C. polaris. Park (1) indicates partial fusion of P1 expl,2 in the female; however, Maclellan and Shih (2) show these two segments as separate. We follow the latter which deals with temperate samples and is a more complete treatment.

References:

1) Park, 1978
2) MacLellan and Shih, 1974
3) Fulton, 1972
4) Cameron, 1957

14.3.1


♀
♀
♂
♂
P5
♀
A2
♂
P1 ♀
P2 ♀
P3 ♀

Chiridius gracilis

from Park, 1975; 1978

14.3.2 *Chiridius polaris* Wolfenden, 1911

Morphology:

FEMALE TL ca. 3.5 mm; Hd rounded; PLC produced as acute points, terminating anterior to midpoint of gnsgt; Ro lacking; Pro:Ur ratio about 3.0; gnsgt ventral process small; A1 reach midpoint Ur2; A2 exp twice enp; P1 bp2 with small spinule at outer distal corner; P2 enp segments poorly separated (1).

MALE Undescribed.

Resembles *C. gracilis*, a smaller copepod, but the fP2 enp has two segments, while in *C. gracilis* the fP2 enp is unsegmented. Also, in *C. gracilis* the PLC extend past the midpoint of the gnsgt.

Distribution and Occurrence:

North Pacific, Antarctic waters (1). Rare locally, but occasionally present in samples from the northern part of the region (2).

Life History:

Juveniles undescribed, key valid for adults only. Note that all copepodites of *Chiridius gracilis*, a similar species, have been described (3).

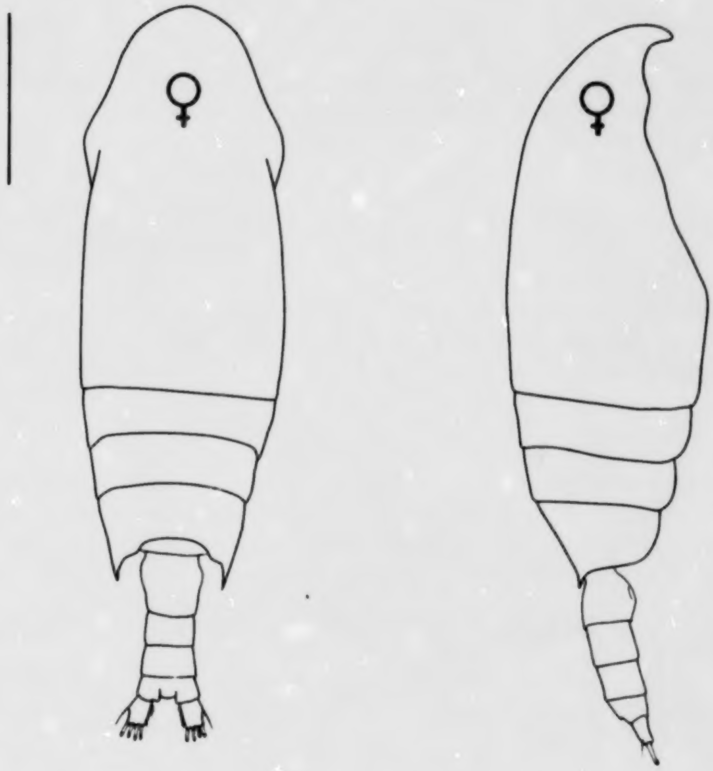
Comments:

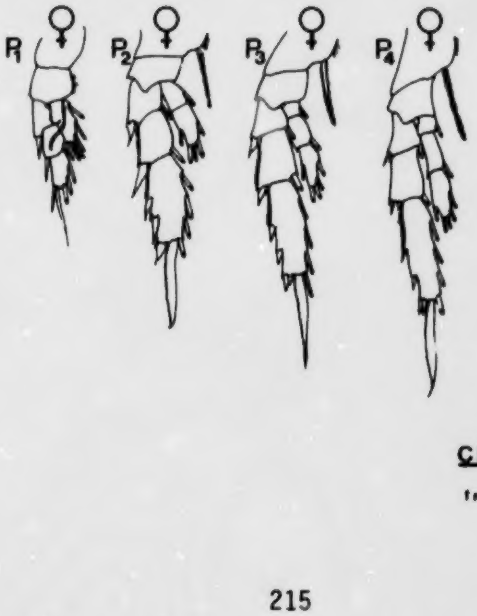
Much rarer in the study area than *C. gracilis*.

References:

1) Brodsky, 1950
2) Gardner, unpublished data
3) MacLellan and Shih, 1974

14.3.2





Chiridius polaris

from Vervoort, 1957

14.4 Gaidius Giesbrecht, 1895

Morphology:

Hd without cephalic process; Ro simple, often with a minutely bifurcated tip. PLC rounded or with spiniform or conical process of varying size and shape. PI expl without spine; P4 bpl with one or more rows of spiniform or bladelike structures (1, 2).

FEMALE mxp bpl with or without lamelliform process on external margin. P5 absent (1, 2).

MALE A1 bearing well-developed aesthetascs. Mouthparts reduced. Mxp bpl without lamelliform process; A2 rami subequal. P5 asymmetrically biramous, each with one segmented enp; lft P5 exp three-segmented; rt exp two-segmented, prehensile (1, 2).

Gaidius and Gaetanus are identical except for the cephalic spine of Gaetanus. Park (2) considers the variability of this character to be such that it does not adequately separate the genera, and he has proposed that the genera be united into the single genus Gaetanus. We have retained both genera.

	Gaidius	Gaetanus	Bradyidius
cephalic spine	n	y	n
rostrum	single	single	bifid

References:

1) Brodsky, 1950
2) Park, 1975a

14.4.1 Gaidius minutus Sars, 1907

Synonymy:

Gaidius columbiae: Park (1967), Fulton (1972)
Chiridius tenuispinus: Campbell (1929b)

Morphology:

PLC produced posteriorly as blunt processes; Ro small, bifurcate at its tip; A1 short, terminating near PLC; P1,2 segmentation: 2-1/3-1; P1 expl with outer distal spine and with incomplete suture (1).

FEMALE TL 2.97-3.20 mm; Pro:Ur ratio about 3.5; P5 lacking; A2 about 1.5 x enp (1).

MALE TL 2.72-3.10 mm; Pro:Ur ratio about 2.7, A2 exp just longer than enp; P5 uniramous asymmetrical; rt P5 heavier than lft; enp one-segmented, rt exp two-segmented, lft exp three-segmented (1).

The blunt processes on the PLC are diagnostic and separate the species from all other similar taxa.

Distribution and Occurrence:

Described from the northeastern Atlantic, the Indian and the Pacific Oceans (1). Locally, abundant and widespread in the study area, but not ubiquitous (1,2,3).

Life History:

Juveniles undescribed, however the blunt processes of the PLC should be diagnostic for the CV and CIV.

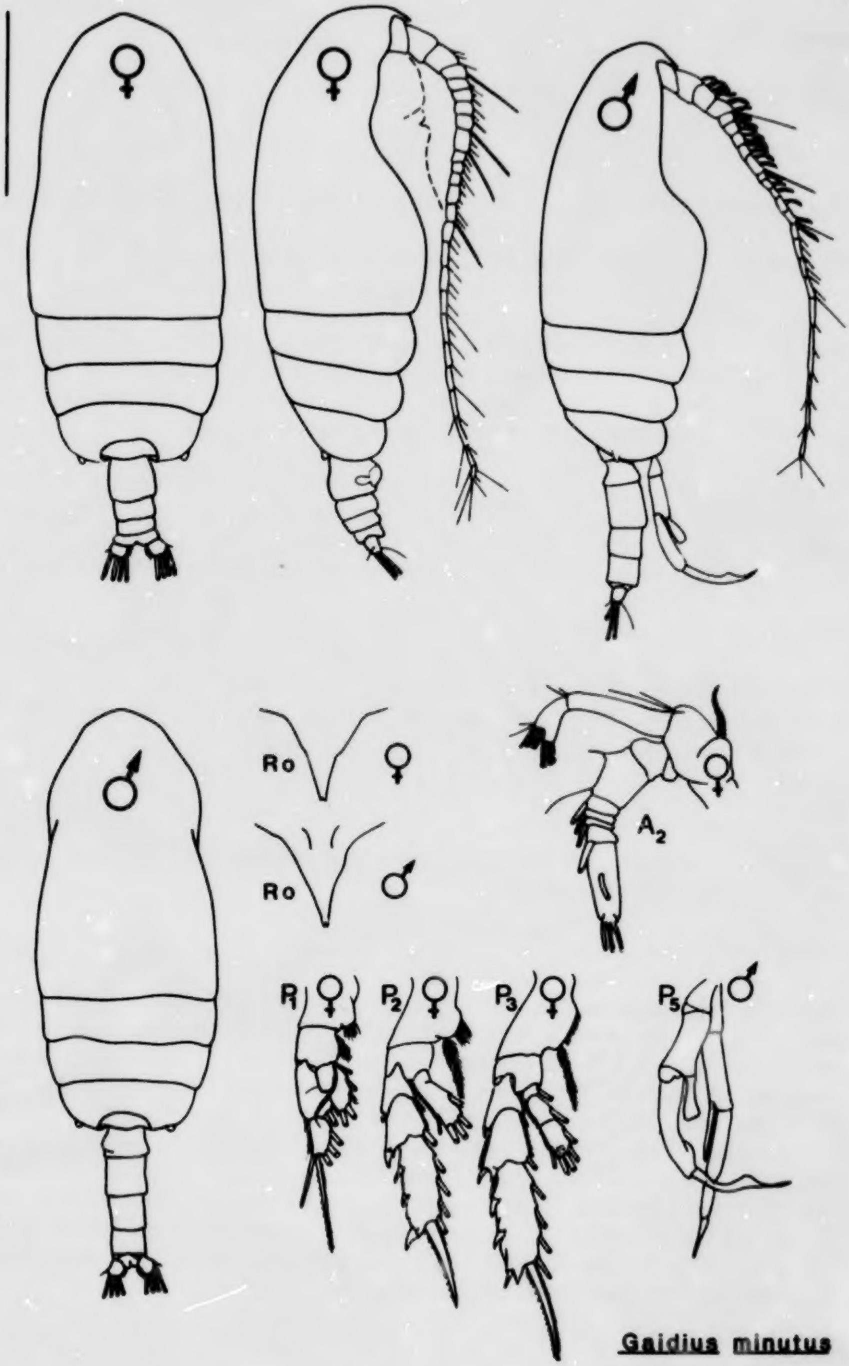
Comments:

Park (1) described G. columbiae as a new species from the Strait of Georgia, but later synonymized G. columbiae with G. minutus (4). However, G. columbiae and G. minutus do not agree in all characters. In particular, G. minutus is reported as having a TL less than 2.72 mm in both sexes (2) and the PLC processes in G. columbiae are uniformly short and blunt, while male G. minutus are armed with spiniform processes. In deference to Park's judgement, we accept his synonymy.

References:

1) Park, 1967b
2) Campbell, 1929b
3) Fulton, 1972
4) Park, 1975a

14.4.1


♀
♀
♂
♂
Ro
♀
Ro
♂
A2
♀
P1
♀
P2
♀
P3
♀
P5
♂

Gaidius minutus

from Park, 1967

14.4.2 Gaidius pungens Giesbrecht, 1895

Synonymy:

Gaidius tenuispinis: Tanaka (1957: male only)

Morphology:

PLC acute; Hd rounded; P1 exp 2-segmented; P2 enp 1-segmented (1,2).

FEMALE TL 2.6-3.8 mm; PLC reach past midpoint gnsgt; Ro undescribed; A1 reaches end Pro; P4 bp2 armed with about 12 long spines (1).

MALE TL 2.0-2.3 mm; Pro:Ur ratio about 3.3; Ro small, with bifurcate apex; A1 reaches distal margin Ur4; P1 exp1 with minute spine and one short, fine seta; P5 biramous, enp reduced to single elongate segment, exp three-segmented (2).

Similar in the male to G. variabilis but smaller and differing in the lack of segmentation in the P2 enp. Note that the P1 exp of G. variabilis may be incompletely separated into three segments, in which case a partial separation between the P1 exp1 and P1 exp2 should be visible.

Distribution and Occurrence:

Reported from all oceans, primarily deep-living (3). Locally, rare but recorded in the Strait of Georgia and occasionally from other coastal stations (4).

Life History:

Juveniles undescribed, however the CV should be identifiable on the basis of P1 exp/P2 enp segmentation.

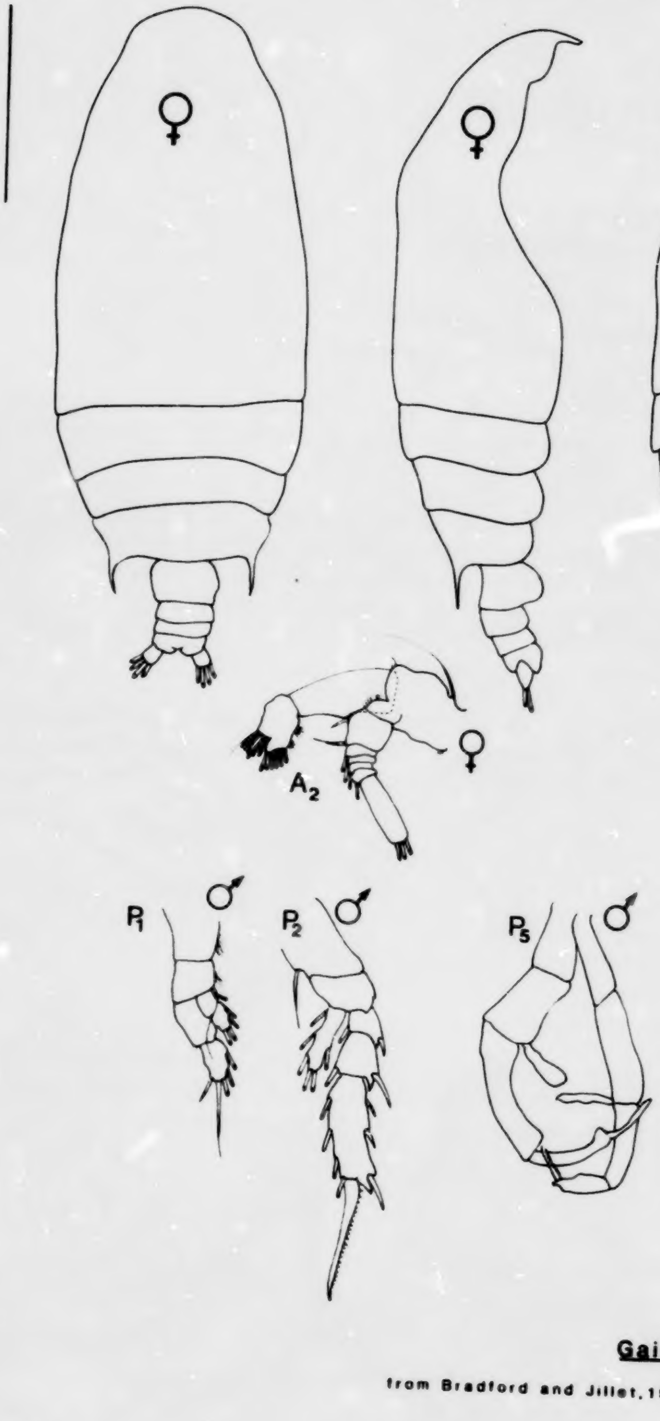
Comments:

There is confusion in the literature concerning the synonymy of this species with Gaidius tenuispinus Sars. Davis (5) considers the two species to be the same, but his specimens conform more closely to G. tenuispinus in having a two-segmented P2 enp, versus an unsegmented P2 enp in G. pungens. Bradford and Jillet (3) support Wolfenden's (6) assertion that Giesbrecht's (7) samples of G. pungens are nevertheless identical to Sars' G. tenuispinus; however, they describe the P2 enp as one-jointed with an obvious fusion line and describe the P1 exp as three-segmented in the adult. Tanaka and Omori (2) show the P1 exp as two-segmented and show no fusion lines in the P2 enp. We follow Brodsky (1), Tanaka and Omori (2), and Park (8) in considering the species to be distinct.

References:

1) Brodsky, 1950
2) Tanaka and Omori, 1970
3) Bradford and Jillet, 1980
4) Fulton, 1972
5) Davis, 1949b
6) Wolfenden, 1904
7) Giesbrecht, 1895
8) Park, 1975

14.4.2



Gaidius pungens

from Bradford and Jillet, 1980; Tanaka, 1970

14.4.3 *Gaidius variabilis* Brodsky, 1950

Synonymy:

Gaidius moderatus: Tanaka (1957)

Morphology:

PLC acute; Hd rounded; Ro robust, minute bifid tip; A1 just shorter than TL; P1exp three-segmented, exp 1 with incomplete suture; P2 enp two-segmented (1,2).

FEMALE TL 3.2-3.8 mm; Pro:Ur ratio about 3.8; PLC variable, extend about 1/3 length gnsgt; gnsgt as long as wide (2).

MALE TL 3.0-3.6 mm; PLC reach midpoint Ur1; ansgt reduced; P5 biramous, enp one-segmented; rt enp heavy, expanded in distal third; lft enp elongate, thin (1,3).

Separable from other members of the genus by the acute, usually thin (but variable) spines of the PLC, P1 exp/P2 enp segmentation (3 and 2 respectively) and length of male A1, which reaches distal margin of Ur3 (but note Brodsky's (1) description, in which male A1 is shorter than this).

Distribution and Occurrence:

Northwestern Pacific, Sea of Okhotsk, Bering Sea, Japanese waters (1,2). Locally, recorded as common in the Strait of Georgia (4) and also seen in the Strait of Juan de Fuca (5). Occasionally seen in other B.C. coastal waters.

Life History:

Juveniles undescribed, however, the CV should be identifiable on the basis of leg segmentation and PLC.

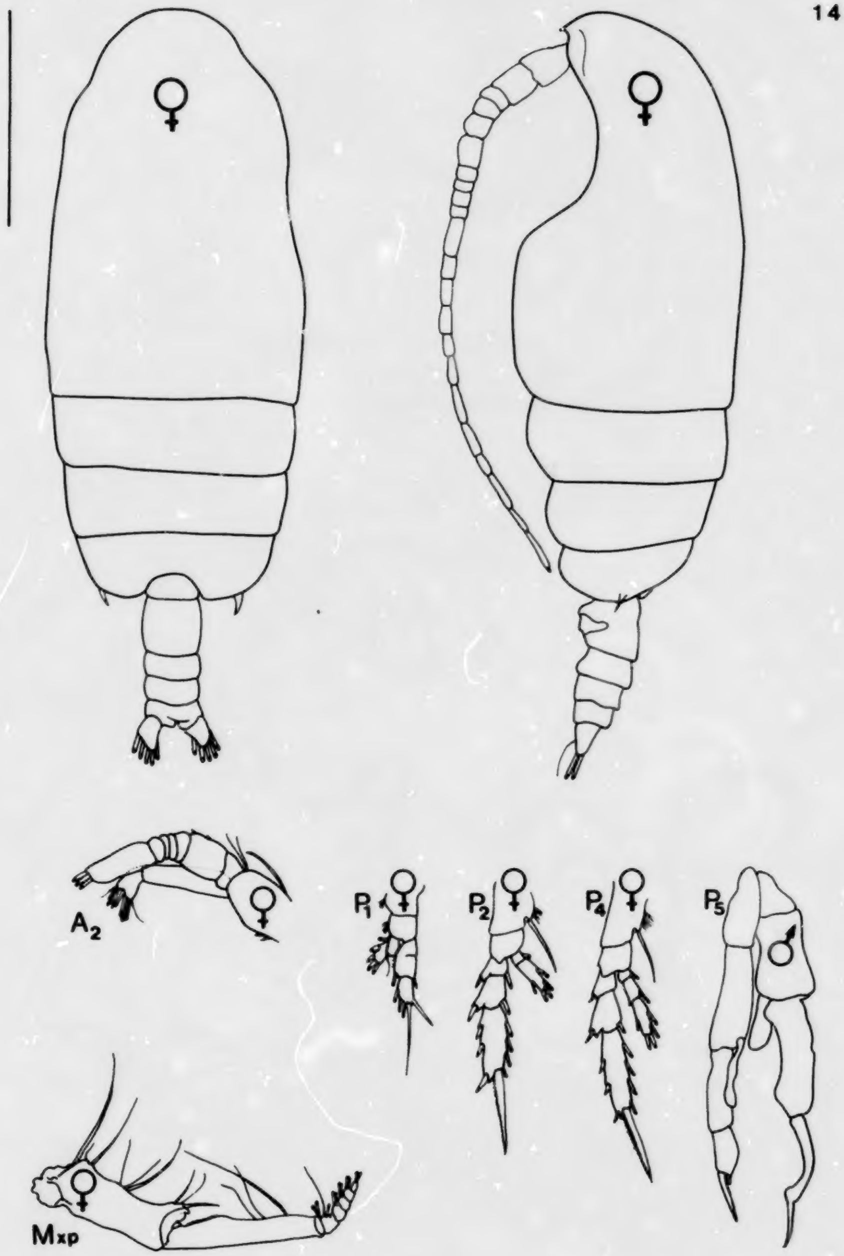
Comments:

Similarities among members of this family, and the variability of the characters, make routine differentiation difficult. Fortunately, only one species, *G. minutus*, is abundant and widespread locally.

References:

1) Brodsky, 1950
2) Tanaka and Omori, 1970a
3) Tanaka, 1957a
4) Fulton, 1972
5) Chester et al., 1980

14.4.3


♀
♀
A2
♀
P1 ♀
P2 ♀
P4 ♀
P5 ♂
♀
Mxp

Gaidius variabilis

from Brodsky, 1950; Tanaka and Omori, 1970; von Vaunpel-Klein, 1970

14.5 Gaetanus Giesbrecht, 1888

Morphology:

Hd usually with cephalic process; Ro simple, often with a minutely bifurcated tip. PLC rounded or with spiniform or conical process of varying size and shape. PI expl without spine, P4 bpl with one or more rows of spiniform or bladelike structures (1, 2).

FEMALE mxp bpl with or without lamelliform process on external margin. P5 absent (1, 2).

MALE AI bearing well-developed aesthetascs. Mouth parts reduced; mxp bpl without lamelliform process; A2 rami subequal. P5 asymmetrically biramous, each with one-segmented enp; lft P5exp three-segmented; rt exp two-segmented, prehensile (1, 2).

Gaetanus and Gaidius are identical except for the cephalic spine of Gaetanus. Park (2) considers the variability of this character to be such that if does not adequately separate the genera, and he has proposed that the genera be united into the single genus Gaetanus. We have retained both genera to better reflect current usage.

	Gaetanus	Gaidius	Bradyidius
Cephalic spine	y	n	n
Rostrum	single	single	bifid

References:

1) Brodsky, 1950
2) Park, 1975a

14.5.1 *Gaetanus intermedius* Campbell, 1930

Synonymy:

armiger: Davis (1949b)
G. simplex: Brodsky (1950)

Morphology:

Hd rounded in profile, but usually armed on the midline with a small cephalic spine pointing obliquely forward; PLC produced as spiniform processes; A1 just exceed PLC (1).

FEMALE TL 2.90-3.51 mm; Pro:Ur ratio about 4.3; PLC extend just beyond midpoint of gnsgt; dorsally, gnsgt symmetrical; laterally, genital prominence pronounced; P4 bp1 with row of spiniform structures on internal margin (1).

MALE TL 2.65-3.10 mm; Pro:Ur ratio about 3.0; cephalic spine small, occasionally lacking; PLC terminate anterior to distal margin gnsgt; P4bp1 without spiniform structures; P5 asymmetrical; rt enp less than ½ rt exp1, lft enp just shorter than lft exp1 (1).

G. intermedius is smaller with a less prominent cephalic spine than other local members of this genus. Park (1) suggests that the male may occasionally lack a cephalic spine, in which case it is still identifiable by size, the acute spines on the PLC and the clearly two-segmented P2 enp and P1 exp. Note that the cephalic spine is small, and may lie flat against the head, difficult to see. It is best viewed in profile.

Distribution and Occurrence:

Reported from the Seas of Japan and Okhotsk, the Bering Sea and northeastern Pacific (1). Usually rare in the study area (1,2,3,4).

Life History:

Shan (2) gives sizes and brief descriptions of all copepodite stages. The presence of a cephalic spine and the relatively small size should separate this species from all other taxa in at least the CIV and CV.

Total Length (mm):

fCV	2.70	fCIV	2.00	CIII	1.55	CI	0.85
mCV	2.65	mCIV	2.00	CII	1.15		

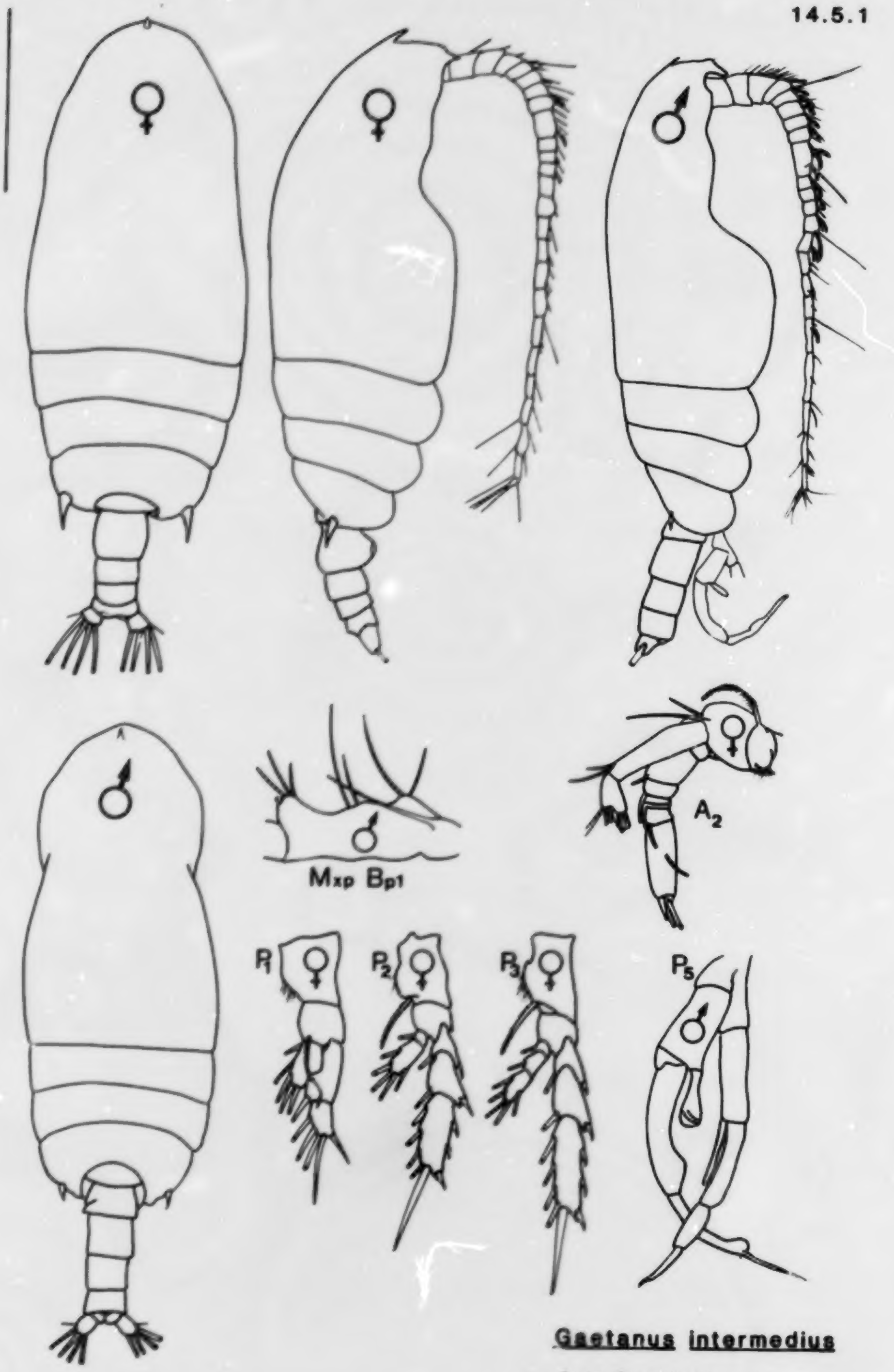
Comments:

Campbell's (3) original description was incomplete, and the species was redescribed by Park (1); Park (5) combines the genera *Gaetanus* and *Gaidius* and renames *G. intermedius* as *G. campbellae* to avoid homynymy with *Gaidius intermedius* Wolfenden, 1905. Here we retain the separation of these two genera.

References:

1) Park, 1973
2) Shan, 1962
3) Campbell, 1930
4) Davis, 1949b
5) Park, 1975

14.5.1


♀
♀
♂
♂
Mxp Bp1
♂
♀
A_2
P_1 ♀
P_2 ♀
P_3 ♀
P_5 ♂

Gaetanus intermedius

from Park, 1973

14.5.2 Gaetanus miles Giesbrecht, 1888

Synonymy:

Gaetanus secundus: Esterly (1911)
G. ferox: With (1915)

Morphology:

A1 at least twice as long as TL; P1 exp and P2 enp two-segmented, P1 expl with incomplete suture; A2 exp about 1.2 x enp (1).

FEMALE TL 3.2-4.7 mm; cephalic spine long, erect; PLC acute, diverging slightly and terminating beyond midpoint of gnsgt; Pro: Ur ratio about 4.6; P4 bpl with row of spines on inner margin (1,2).

MALE TL 3.0-3.55 mm; Hd spine reduced to small crest, PLC rounded; A1 approximately equals total length (3).

Distribution and Occurrence:

Wide-ranging over the tropical, subtropical, and temperate regions of the world's oceans. Usually deep, but often in near-surface waters (4). Locally, rare but recorded in Queen Charlotte Strait (5).

Life History:

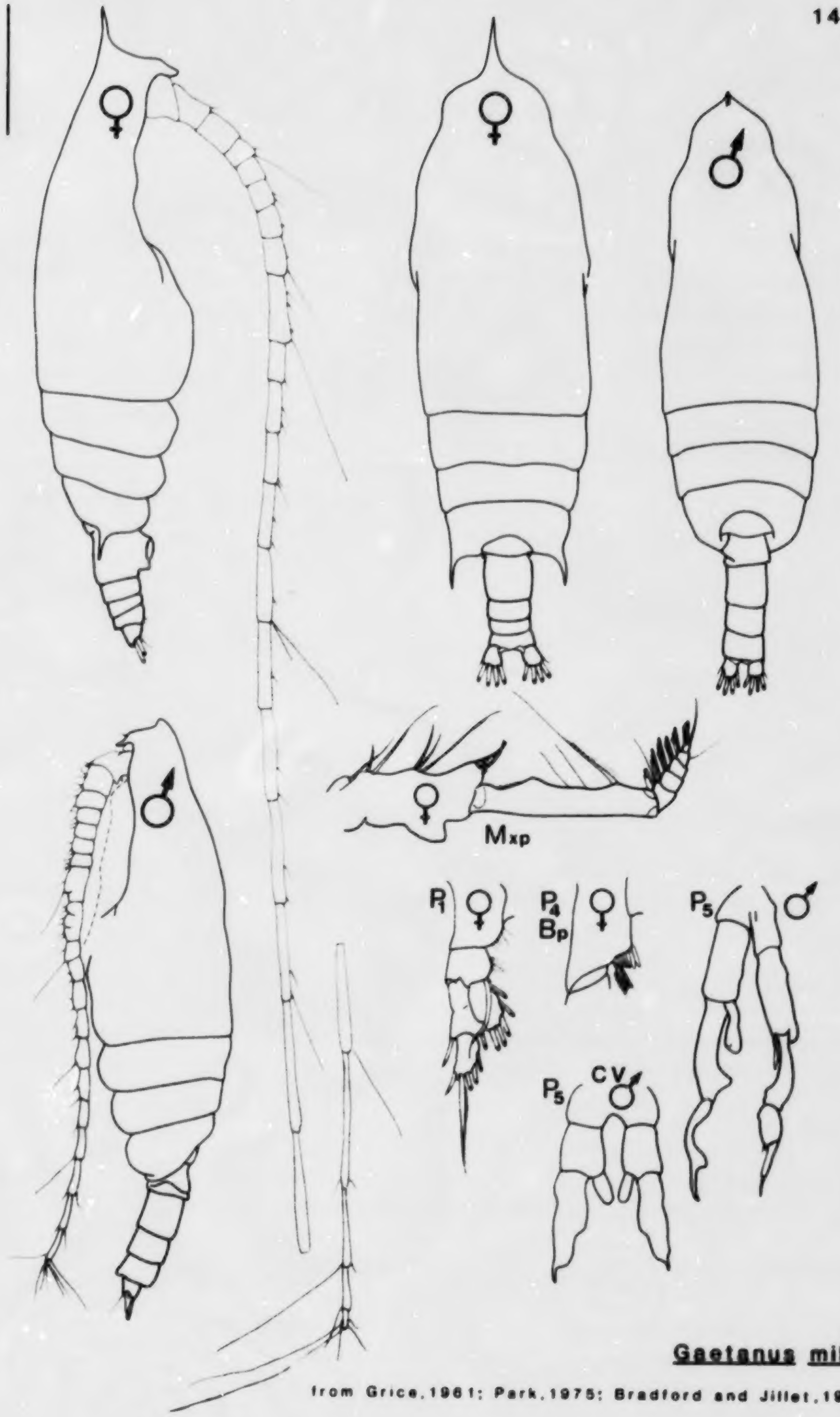
Juveniles undescribed, although Vervoort (4) gives the lengths of the CV male and female, which he characterizes as easily recognizable by the long A1 and prominent head spine. Grice (6) briefly describes the CV male P5. Size ranges: CV female 2.5-3.2 mm, CV male 3.0 mm.

Comments:

Likely an indicator of intruding oceanic water containing a significant proportion of southern water (i.e. originating near the California coast).

References:

1) Tanaka, 1957b
2) Brodsky, 1950
3) Bradford and Jillett, 1980
4) Vervoort, 1963
5) Stone, 1980
6) Grice, 1962


♀
♀
♂
♂
♀
Mxp
P_1 ♀
P_4 B_p ♀
P_5 ♂
P_5 CV ♂

Gaetanus miles

from Grice,1961; Park,1975; Bradford and Jillet,1980

14.5.3 Gaetanus pileatus Farran, 1903

Synonymy:

Gaetanus caudini: Wolfenden (1904); Sars (1905)
G. unicornis: Esterly (1906)
G. recticornis: Wolfenden (1911)
G. clarus: Esterly (1906)

Bradford and Jillet (1980) point out that Sars' (1925) plate 17 may be confused, and Fig. 6, identified as the mP5 from G. pileatus, is in fact the mP5 of G. latifrons.

Morphology:

PLC acute, cephalic spine large, obvious; A2 rami subequal; PI exp two-segmented (1)

FEMALE TL 4.90-6.65 mm; Pro:Ur ratio approximately 4.2; cephalic spine erect; PLC extend to midpoint gnsgt; A1 exceed TL; gnsgt as long as wide; in lateral view, dorsal profile of gnsgt contricted anteriorly (1).

MALE TL 4.44-5.08 mm; cephalic spine directed antero-ventrally, PLC reduced; P5 biramous, enp one-segmented, exp three-segmented (2).

Unique in its large size and large cephalic spine.

Distribution and Occurrence:

Widely distributed over the tropical, subtropical and temperate zones of the world oceans, but nowhere abundant (3). Locally, rare but recorded from Queen Charlotte Strait (4).

Life History:

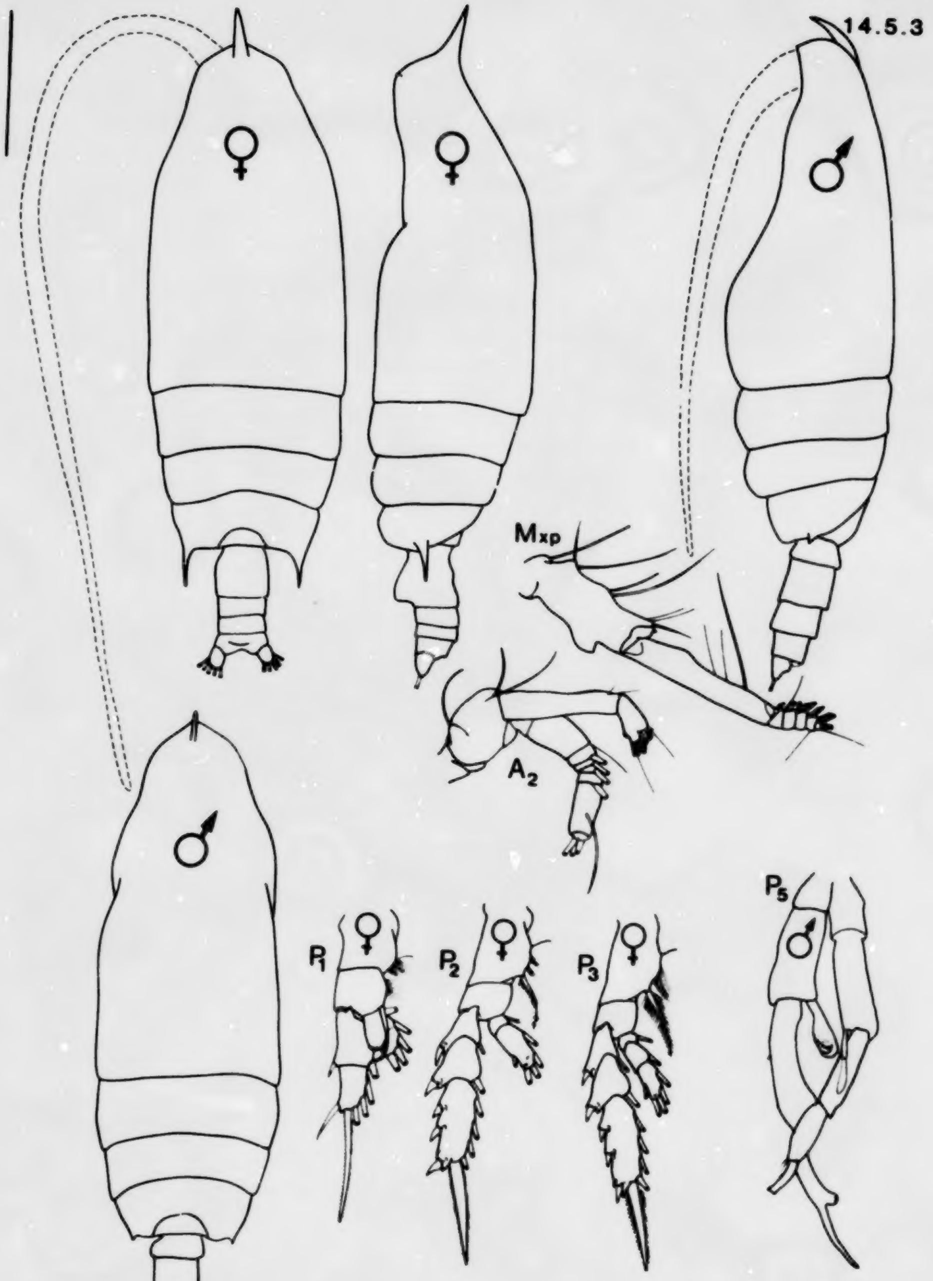
Juveniles undescribed; however the CIV and CV should be separable by size and the large cephalic spine.

Comments:

Likely an indicator of intruding water composed in part of water of southern origin (i.e. near the California coast).

References:

1) Tanaka, 1957b
2) Park, 1978
3) Vervoort, 1963
4) Stone, 1980



14.5.3
♀
♀
♂
Mxp
A$_2$
♂
P$_1$ ♀
P$_2$ ♀
P$_3$ ♀
P$_5$ ♂

Gaetanus pileatus

from Park, 1978

14.6 Euchirella Giesbrecht, 1888

Morphology:

Hd usually rounded, occasionally with triangular crest; PLC rounded; Ro single, occasionally absent. Thorax three or four-segmented; Ur thick; ansgt and CR short, CR setae asymmetrical. A2 enp much shorter than A2 exp. Max1 rami short, inner lobe with massive, uncinate bristles. P1,2 segmentation: 2-1/3-1; P1 exp1 with spine. P4 bp1 with one or more spines at the base of inner distal setae.

FEMALE Ur four-segmented; gnsgt in dorsal view usually asymmetrical, ventral swelling distinct, occasionally large. P5 absent (1, 2).

MALE Ur five-segmented; mouthparts reduced. P5 biramous, asymmetrical; lft P5 enp small, one-segmented; lft P5 exp three-segmented; rt P5 enp strongly developed, exp two-segmented, terminal segment with teeth or plates along internal margin (1,2).

The short CR and Ur separate this genus from others with rounded PLC.

	Euchirella	Pseudochirella	Undeuchaeta or Chirundina	Aetideus
A2 exp longer than twice A2 enp	y	y	y	n
Hd cristate	usually not	usually not	+	n
spines present on fP4 bp1	y	y	n	y
Th4/5 fused	y	n	y	y

References:

1) Brodsky, 1950
2) Vervoort, 1952g (Fiches, Sheet 47)

14.6.1 Euchirella curticauda Giesbrecht, 1888

Synonymy:

Euchirella curticauda var atlantica: Wolfenden (1904); Pearson (1906)
E. atlantica: Wolfenden (1905)
Scolecithrix cristata (male): Thompson (1903)

Vervoort (1963) reviews the genus and provides extensive references to E. curticauda.

Morphology:

PLC rounded; Hd cristate, crest somewhat triangular in lateral view; Ro small, single; A1 approximately equal Pro length; CR short (1, 2).

FEMALE TL 3.3-4.5 mm; gnsgt symmetrical in dorsal view, slightly swollen laterally; length of gnsgt equals ½ length Ur; Ur 3 with small ventral projection; Pro:Ur ratio about 6.0; A2 exp 4x enp; P4 bpl with row of usually more than 10 spines at base of inner marginal seta (1, 2).

MALE TL 3.1-4.3 mm; A2 exp 1.4 x enp; P5 biramous; lft P5 enp one-segmented and about ½ expl; exp3 small, originating subterminally to form a chela with a long distal process of exp2; rt 5enp one-segmented, club-shaped, approximately equal to rt expl; rt P5 non-chelate (1,2).

The short CR, rounded PLC and crestate head separate this species from most others. Separable from similar species of Euchirella by the symmetrical gnsgt in the female and non-chelate rt P5 in the male respectively.

Distribution and Occurrence:

Widespread in the Atlantic, Pacific and Indian Oceans, but usually in small numbers. Locally, reported in the vicinity of Cape Flattery (3), and in Queen Charlotte Strait (4).

Life History:

Juveniles undescribed, key valid for adults only.

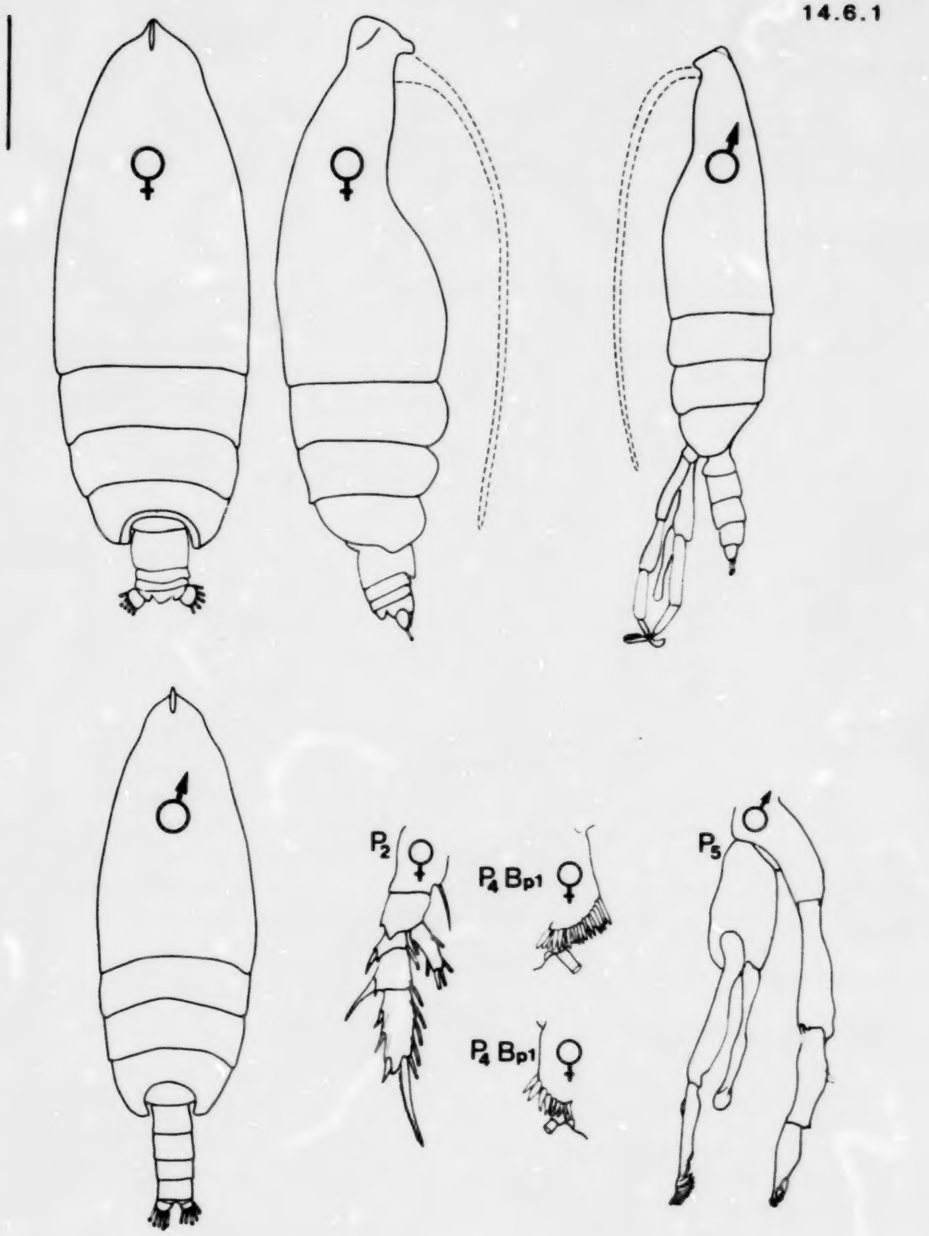
Comments:

A more southerly species along the eastern North Pacific, perhaps indicating northward intrusions of southern water when found off the British Columbia coast.

References:

1) Tanaka, 1957b
2) Park, 1976b
3) Davis, 1949b
4) Stone, 1980

14.6.1


♀
♀
♂
♂
P_2 ♀
P_4 B_{p1} ♀
P_4 B_{p1} ♀
P_5 ♂

Euchirella curticauda

from Brodsky,1950;Tanaka,1957; Bradford and Jillett,1980

14.6.2 *Euchirella pulchra* (Lubbock, 1956)

Synonymy:

Undina pulchra (male): Lubbock (1856)
Calanus latus (female): Lubbock (1856)
Euchaeta pulchra: Brady (1883: male only); T. Scott (1894)

Morphology:

PLC rounded; A2 exp about 3-4 x enp; Ro single, well developed (1).

FEMALE TL 3.0-3.9 mm; Hd rounded, not cristate; gnsgt asymmetrical in dorsal view, with large protuberance on lft side, P4 bpl with one or two large spines at base of inner distal seta (1).

MALE TL 3.00-3.16 mm; Hd in dorsal view with a low crest; lft P5 enp lacking; lft P5 exp much reduced with respect to rt P5; rt enp and exp both tapering distally, of complex shape but arranged in the form of a chela (1).

Separable from most other local members of the genus by the asymmetrical gnsgt (female) and chelate form of the rt P5 (male). Similar to *E. pseudopulchra*, but smaller and with less than three spines at the base of the inner marginal seta of P4 bpl. Lacks a crest in the female.

Distribution and Occurrence:

Confirmed records in the Atlantic, from 19°S to 50°N; reported from the Gulf of Guinea, the coasts of Brazil and Chile, and widspread temperate and tropical regions of the Pacific (2). Confusion with *E. pseudopulchra* in the northeastern Pacific makes distributional records difficult to interpret. Likely rare, and perhaps absent, in the study area.

Life History:

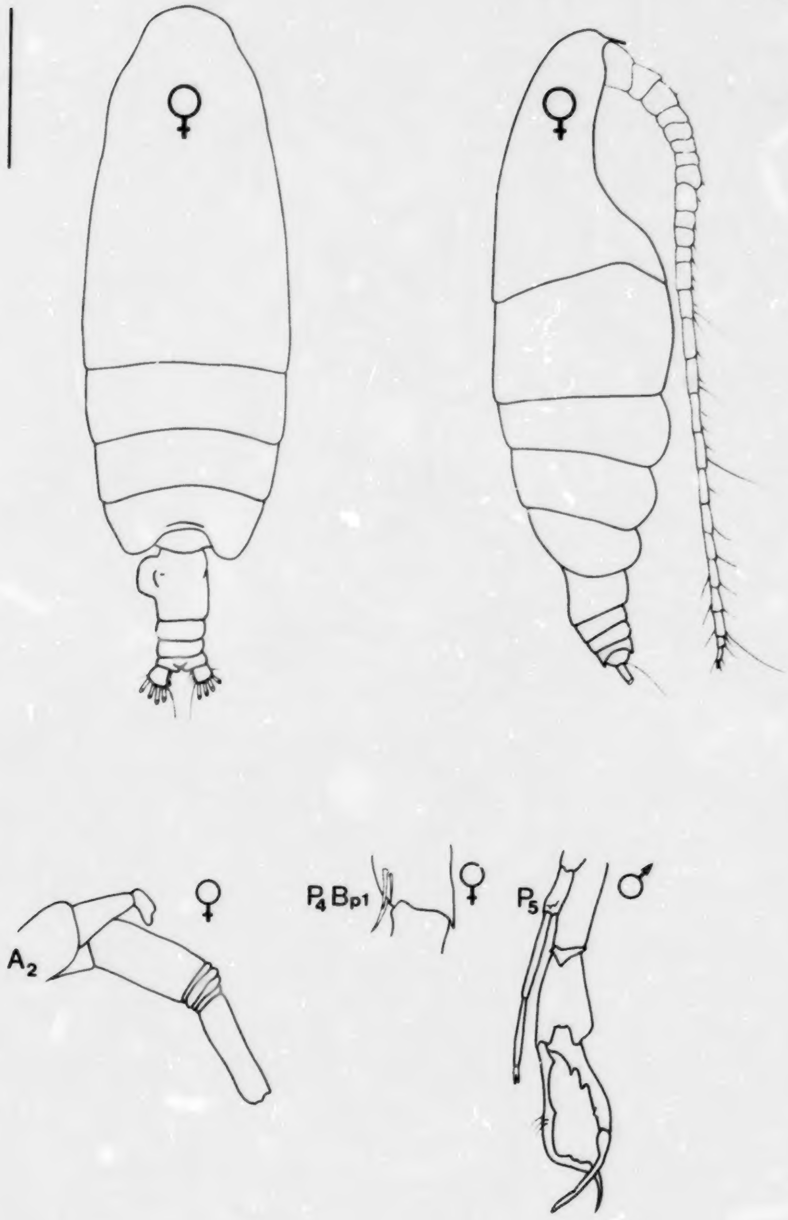
Juveniles undescribed, key valid for adults only.

Comments:

Park re-examined specimens of *Euchirella* from British Columbia waters and found that they differed substantially from *E. pulchra*. Accordingly, he designated the British Columbia taxon as a new species, *E. pseudopulchra*, and suggested that Davis' (3) record of *E. pulchra* was in fact *E. pseudopulchra*. Esterly (4) also reported *E. pulchra* from the west coast of North America, but his figures are not adequate to allow evaluation of his identification. The size of Esterly's specimens conforms to *E. pulchra*. This species needs further taxonomic and distributional study.

References:

1) Park, 1976a
2) Vervoort, 1963
3) Davis, 1949a
4) Esterly, 1905



Euchirella pulchra

from Esterly, 1905; Sars, 1925; Park, 1967

14.6.3 Euchirella pseudopulchra Park, 1976

Morphology:

FEMALE TL 4.20-4.35 mm; Ur short, gnsgt asymmetrical, in dorsal view rt profile concave, lft profile convex; CR short; A1 extends to distal margin gnsgt; Hd with a low crest; A2 exp 3-4 x enp; P4 bpl with three spines at base of inner distal seta (1).

MALE Undescribed.

Separable from other members of the genus by the cristate head, left sided asymmetry of the gnsgt and presence of three spines in the P4 pbl.

Distribution and Occurrence:

Reported only from the northeastern Pacific, specifically the Strait of Georgia, the Strait of Juan de Fuca, Washington Sound, the coasts of northern California, Oregon and Washington, and Queen Charlotte Strait (1,2,3,4). Rare at all inshore stations, and in low numbers offshore.

Life History:

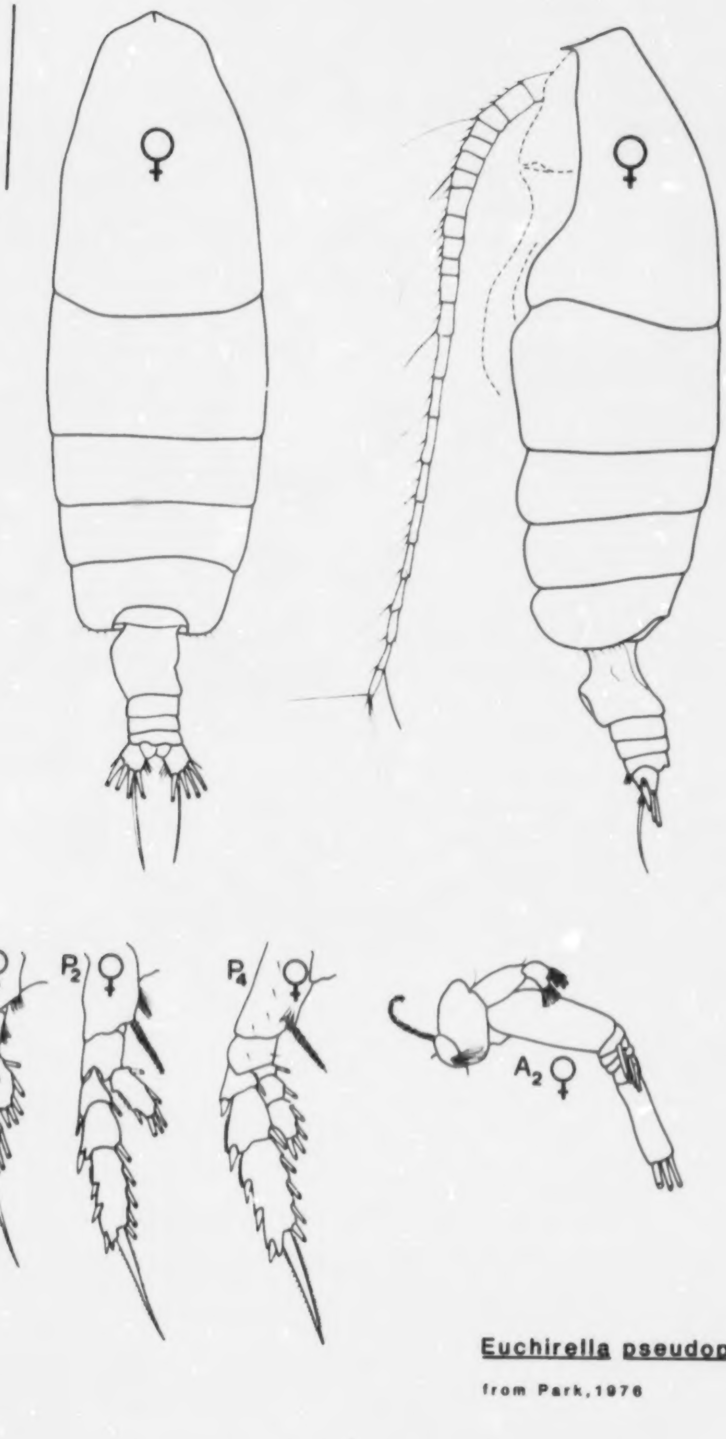
Juveniles undescribed, key valid for adults only.

Comments:

The taxonomy of this species needs clarification. Davis (3) describes both the male and female of E. pulchra from the northeastern Pacific, but Park's (1) redescription of the species in this area as E. pseudopulchra indicates the male as being undescribed.

References:

1) Park, 1976a
2) Stone, 1980
3) Davis, 1949b
4) Fulton, 1972



Euchirella pseudopulchra

from Park, 1976

14.6.4 Euchirella rostrata (Claus, 1866)

Morphology:

Hd rounded, not cristate; Ro large, single; PLC rounded; A1 approximately equal TL; A2 enp less than ½ exp (1).

FEMALE TL 2.5-3.9 mm (usually less than 3.5 mm); gnsgt symmetrical in dorsal view, broadly swollen laterally; P4 bpl with row of 5 to 9 spines, diminishing in size towards distal margin of segment (1).

MALE TL 2.5-3.0 mm; lft P4 bp2 much longer than rt; P5 rami biramous, enp one-segmented, just shorter than expl; rt exp two-segmented, tapering distally, not chelate (1).

Separable from other local members of the genus by the rounded head, symmetrical gnsgt (female), and non-chelate form of the rt mP5 rami (male). Five or more spines near the base of the inner marginal seta of P4 bpl.

Distribution and Occurrence:

Widely recorded from the tropical, subtropical and temperate regions of the world's oceans (2). Locally, rare but reported from the Strait of Georgia and Queen Charlotte Strait (3,4).

Life History:

Juveniles undescribed, however, the CV may be separable based on the lack of a crest and the spinulation of the P4 bpl.

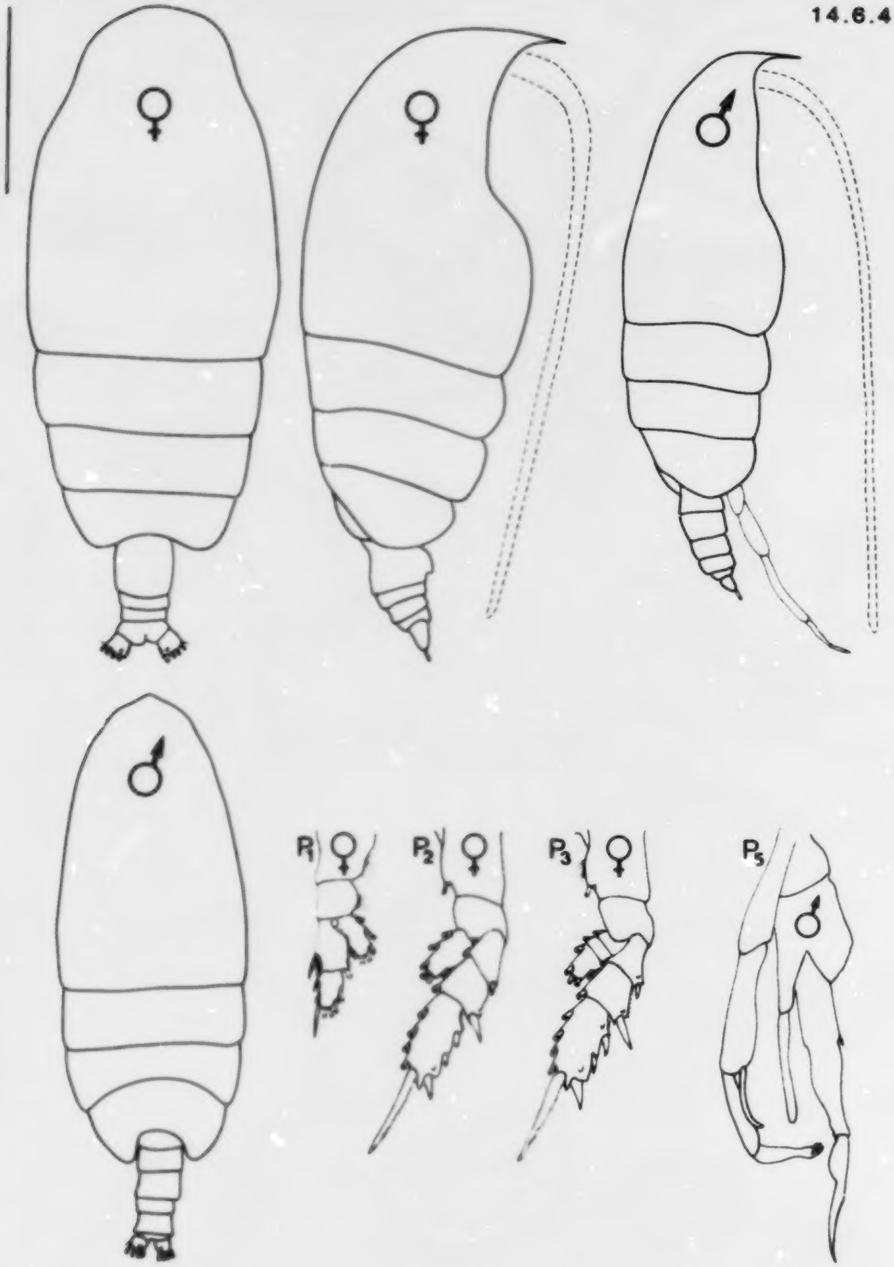
Comments:

Park (1) describes this and two other local species and comments briefly on their feeding ecology.

References:

1) Park, 1976b
2) Vervoort, 1963
3) Fulton, 1972
4) Stone, 1980

14.6.4



Euchirella rostrata

from Bradford and Jillett, 1980

14.7 *Chirundina* Giesbrecht, 1895

Morphology:

Hd with crest; Ro single, prominent and sharp. PLC wide, with short blunt projections; thorax three-segmented. A1 only slightly longer than thorax; A2 enp at least ½ length of A2 exp. P1 expl with spine; P4 bp2 without spines (1).

FEMALE Hd with high , triangular crest confined to head apex. P1 segmentation 2-1; P5 absent (1).

MALE Hd with low, wide crest. P1 segmentation 3-1. P5 large, biramous, slightly asymmetrical; exp three-segmented; rt P5 exp3 terminating with a spine, lft P5 exp3 with terminal bundle of bristles on ventral surface (1).

	Chirundina	*Pseudochirella* or *Euchirella*	*Undeuchaeta*	*Aetideus*
A2 exp longer than twice A2 enp	y	y	y	n
Hd cristate	y	usually not	n*	n
spines present on f P4 bpl	n	y	n	y
f gnsgt	without spines	without spines	spines	without spines

* Some species of *Undeuchaeta* have cristate heads; however, these species are not found in the study area.

References:

1) Brodksy, 1950

14.7.1 Chirundina streetsi Giesbrecht, 1895

Synonymy:

Euchirella carinata: Wolfenden (1902, 1903, 1904, 1905, 1911)

Morphology:

A large copepod with cristate Hd, rounded or angular PLC and A1 terminating near ansgt; A2 exp 1.6 x enp; CR short; P1 expl with spine at outer distal corner (1).

FEMALE TL 3.6-6.0 mm; Pro:Ur ratio about 3.7; ansgt reduced, gnsgt just less than ½ length Ur; in lateral view gnsgt ventral swelling most pronounced distally (1).

MALE TL 3.8-5.0 mm; Hd crest low, may not be immediately obvious; Pro:Ur ratio about 2.7 (1).

Distribution and Occurrence:

Widely distributed in the world's oceans, usually in deep water. Vervoort (2) summarizes the distribution. Locally, recorded in Queen Charlotte Strait (3).

Life History:

Juveniles undescribed; however, the CV at least should be separable based on size, rostrum and crest.

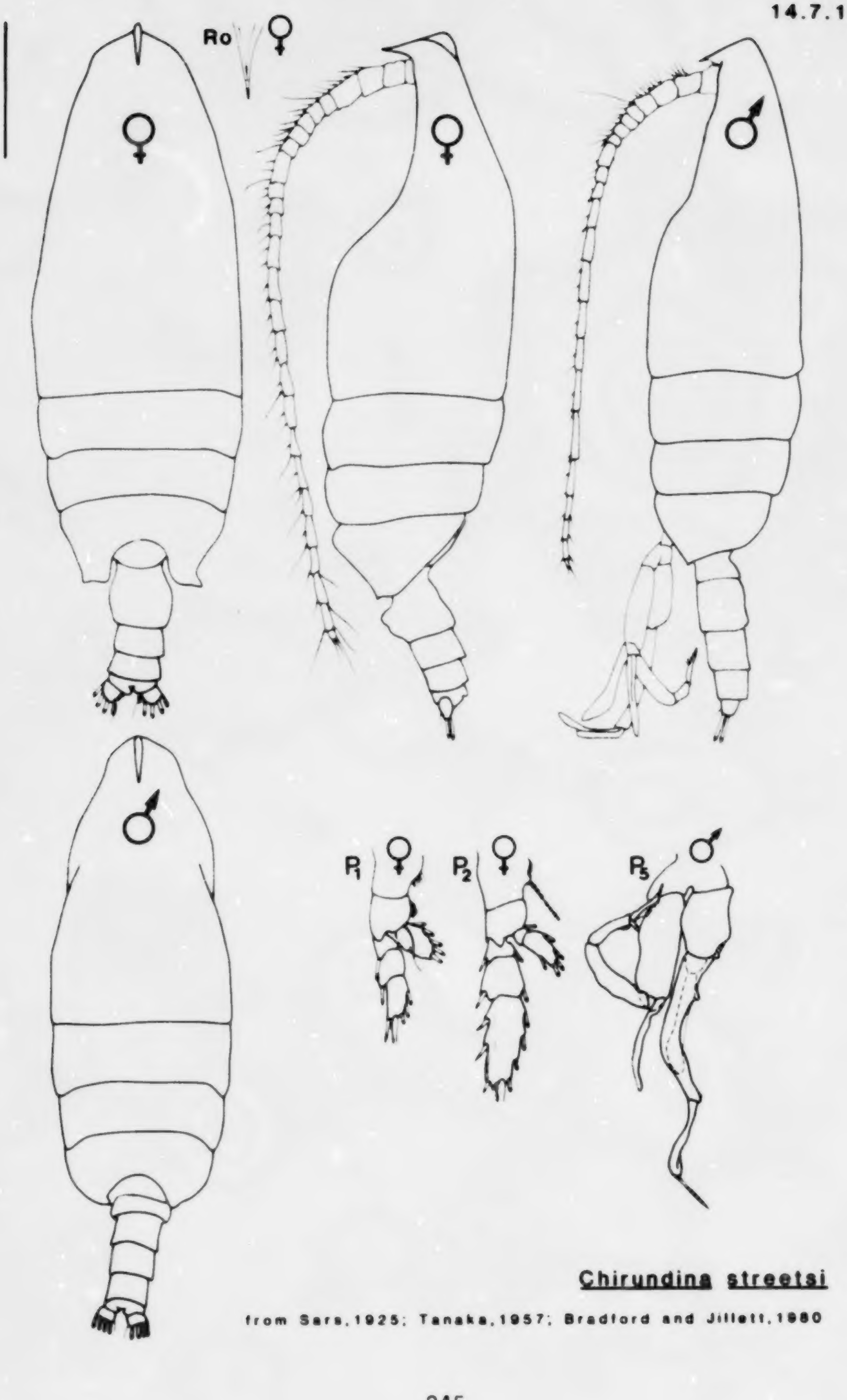
Comments:

Rare in the study area, and except in special circumstances restricted to open water.

References:

1) Tanaka, 1957b
2) Vervoort, 1963
3) Stone, 1980

14.7.1



Chirundina streetsi

from Sars,1925; Tanaka,1957; Bradford and Jillett,1980

14.8 Undeuchaeta Giesbrecht, 1888

Morphology:

Hd rounded or cristate; PLC usually pointed and produced backwards, rarely rounded; Ro single, large; A1 short, A2 enp at least ½ length of A2 exp. P1,2 segmentation variable; P4 bp2 without spines (1).

FEMALE gnsgt shape asymmetrical; armature of a few isolated spines; P5 absent (1).

MALE Mouth parts reduced; P5 biramous, asymmetrical; lft enp rudimentary, much smaller than rt (1).

	Undeuchaeta	Pseudochirella or Euchirella	Chirundina	Aetideus
A2 exp longer than twice A2 enp	y	y	y	n
Hd cristate	n*	usually not	y	n
spines present on f P4 bpl	n	y	n	y
f gnsgt	spines	without spines	without spines	without spines

* Some species of Undeuchaeta have cristate heads; however, these species are not found in the study area.

References:

1) Brodsky, 1950

14.8.1 Undeuchaeta bispinosa Esterly, 1911

Morphology:

FEMALE TL 4.5 mm; Hd rounded; PLC acutely angular; A1 as long as Pro; CR short; Ro single; gnsgt with rounded process on rt side; small spine at distal margin of process (about level with genital aperture); small curved spine to rt of genital aperture and group of massive spines on lft distal margin of gnsgt; P1 expl with outer distal spine; P5 absent(1).

MALE The only reported description of the male is by Sewell (2).

Distribution and Occurrence:

Reported from the coast of California (3) and from Queen Charlotte Strait (4). Bradford and Jillett (5) indicate that Sewell (2) described the male of this species from the Indian Ocean.

Life History:

Juveniles undescribed; however, the CV should be separable based on the following features: short CR and A1, single Ro, P1 expl spine and possibly acute apices on PLC.

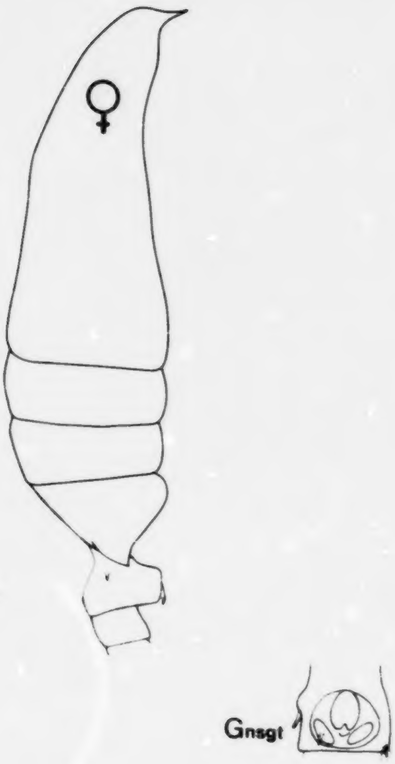
Comments:

Neither Esterly's (3) nor Brodsky's (1) description is complete, and further clarification will require study of the type specimens.

References:

1) Brodsky, 1950
2) Sewell, 1929
3) Esterly, 1911
4) Stone, 1980
5) Bradford and Jillett, 1980

14.8.1



Undeuchaeta bispinosa

from Esterly, 1911

14.9 Pseudochirella Sars, 1920

Morphology:

Thorax four- or five-segmented; Hd almost always without crest; PLC rounded or provided with spine. Ro prominent, single. A1 equal or longer than TL. A2 enp at least ½ length A2 enp. P1,2 segmentation variable usually 2-1/3-1; P4 bpl with 6-14 strong spinules on posterior surface. P2-P4 exp terminal spines with a very strong row of hairs along internal border (1, 2).

FEMALE gnsgt without spines, P5 absent (1, 2).

MALE P5 biramous, asymmetrical; swollen bp1,2; enp elongate, one-segmented; lft P5 exp with three short segments, rt enp with two elongate segments (1, 2).

	Pseudochirella	Euchirella	Chirundina	Undeuchaeta	Aetideus
A2 exp longer than twice A2 enp	y	y	y	y	n
Hd cristate	usually not	usually not	y	n*	n
spines present on f P4 bpl	y	y	n	n	y
Th4/5 fused	n	y	y	y	y
f gnsgt	without spines	without spines	without spines	spines	without spines

* Some species of Undeuchaeta have cristate heads; however, these species are not found in the study area.

References:

1) Brodsky, 1950
2) Vervoort, 1952h (Fiches, Sheet 48)

14.9.1 Pseudochirella polyspina Brodsky, 1950

Synonymy:

Pseudochirella spinifera: Brodsky (1950); Tanaka and Omori (1969b); von Vaupel- Klein (1970)
NOT P. polyspina: Tanaka and Omori (1969b: male only)

Morphology:

Hd, PLC rounded; Ro single; A1 approximately equal to TL; A2 exp about ½ enp; P1 expl with spine (1,2).

FEMALE TL 5.65-6.50 mm; Pro:Ur ratio about 3.6; gnsgt just less than ½ Ur; gnsgt spinulose along distal and lateral margins; P4 bpl with row of spines on inner margin (1).

MALE TL 4.83-5.33 mm; Pro:Ur ratio about 2.8; PLC rounded but may have two small spines on dorsal margin; P5 biramous, rami slender without setae or projections (2).

Distribution and Occurrence:

Reported from the northwestern and northeastern Pacific Ocean, the Bering Sea, Sea of Okhotsk, Sea of Japan, Indian Ocean and Antarctic waters (3). Locally, reported from the Strait of Juan de Fuca (4).

Life History:

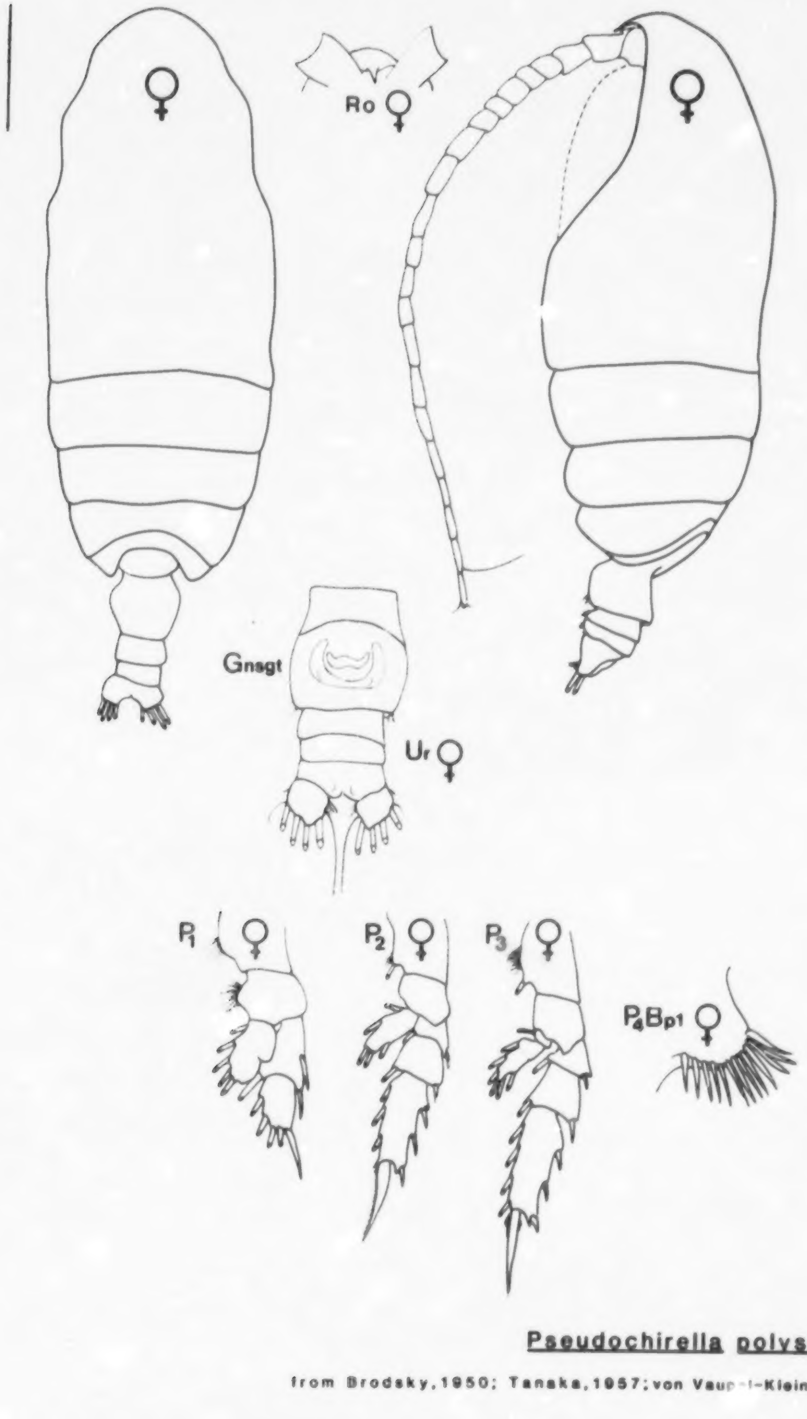
Juveniles undescribed; however, the characters used in the key should apply equally to the CV, and perhaps the CIV.

Comments:

The name of this species derives from the heavy spinulation of the female urosome.

References:

1) Tanaka, 1957b
2) Tanaka and Omori, 1969b
3) Park, 1978
4) Chester et al., 1980


♀
Ro ♀
♀
Gnsgt
Ur ♀
P1 ♀
P2 ♀
P3 ♀
P4Bp1 ♀

Pseudochirella polyspina

from Brodsky,1950; Tanaka,1957;von Vaupel-Klein,1970

14.10 Azygokeras Koeller and Littlepage, 1976

Morphology:

Thorax four-segmented; PLC with acute points; Hd rounded; Ro absent. Posterior borders of Ur segments spinulose. A2 rami subequal. P1 expl with spine; P1-2 segmentation 3-1/3-2; P2-P4 enp posterior surfaces spinulose; P4 spinulation finer and more dense than P2,3; P2,3 bp1,2 with spinule on external margin (1).

FEMALE mxp massive and conspicuous; P5 absent (1).

MALE Mouth parts reduced; A1 slightly asymmetrical, rt A1 stouter distally and bent backward at about the third distal segment; P5 biramous and asymmetrical, enp one-segmented (1).

The asymmetrical mA1 and spinulation of P1-P4 separate this genus from all others.

	Azygokeras	Aetideus	Bradyidius	Chiridius	Euchirella
A2 rami subequal	y	y	y	n	n
f Ro	n	y	y	n	y/n
m Ro	n	n	y	n	y/n
P1 expl spine	y	n	y	y	y
m P5	biramous	uniramous	biramous	uniramous	biramous
length ratio, rt mP5:lft m P5	#	0:1	#	1:1.2	#

References:

1) Koeller and Littlepage, 1976

14.10.1 Azygokeras columbiae Koeller and Littlepage, 1976

Morphology:

Ro absent; PLC acute; Hd rounded; A1 approximately equal to TL; P1 expl with outer distal spine (1).

FEMALE TL 2.58-2.84 mm, Pro stout; Pro:Ur ratio about 3.5; PLC points reach midpoint gnsgt; gnsgt large, ansgt reduced (1).

MALE TL 2.00-2.10 mm; Pro more slender than in female; rt A1 with distal six segments enlarged; Pro:Ur ratio about 3.0; PLC reduced somewhat; ansgt reduced; mouthparts reduced; P5 biramous, lft bp1 equal to rt bp1 and bp2 combined, enp one-segmented; lft P5 much longer than rt (1).

Distribution and Occurrence:

Recorded only from deep water in Bute Inlet, British Columbia (1).

Life History:

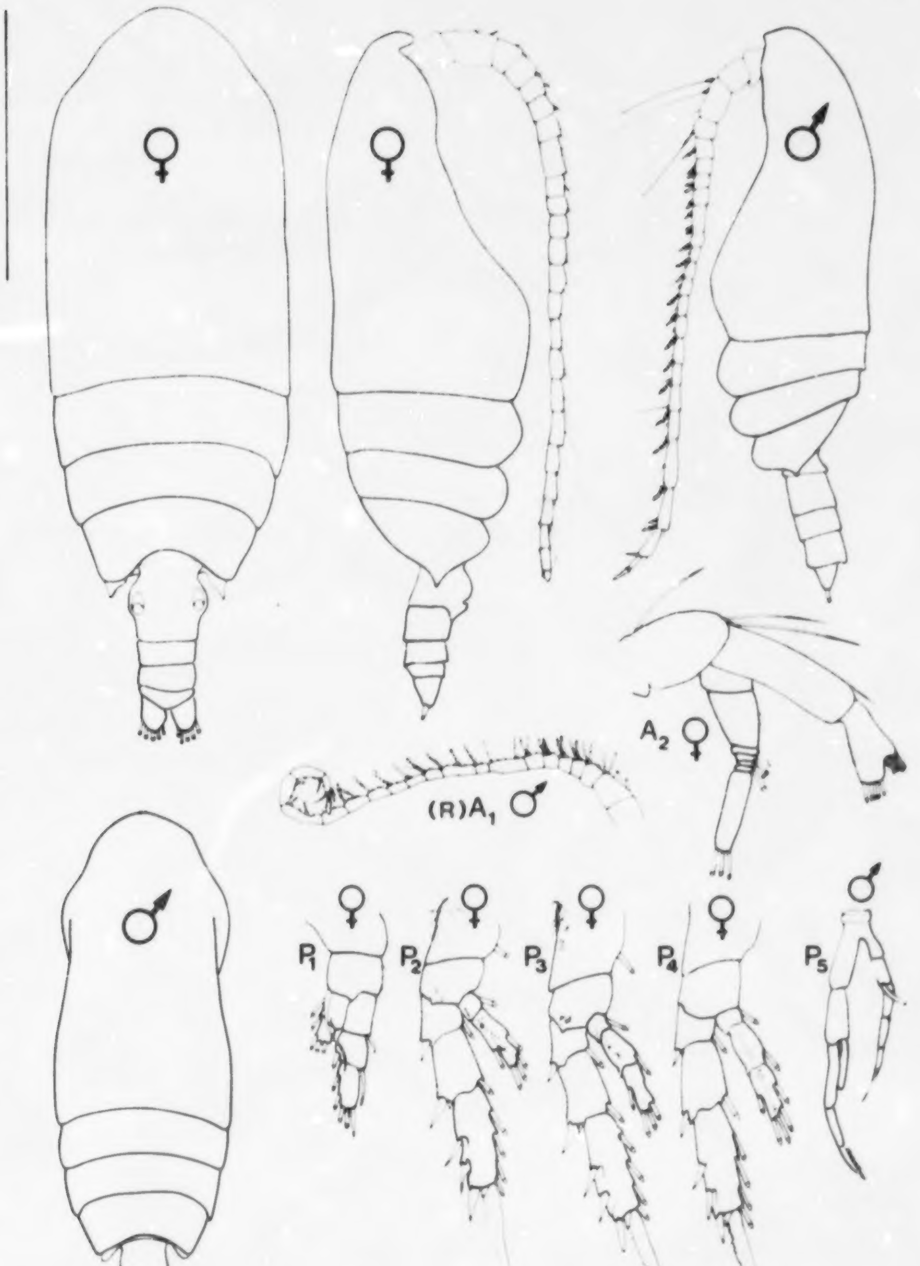
Juveniles undescribed; however, with the exception of male A1 asymmetry the characters used in the key should enable separation of the CV.

Comments:

This species is apparently epibenthic, and represents a niche that is poorly sampled by standard zooplankton collecting techniques. More extensive sampling with appropriate equipment might uncover a relatively large and diverse copepod fauna associated with, but living above, the sea bed in the study area.

References:

1) Koeller and Littlepage, 1976


♀
♀
♂
A₂ ♀
(R)A₁ ♂
♂
P₁ ♀
P₂ ♀
P₃ ♀
P₄ ♀
P₅ ♂

Azygokeras columbiae

from Koeller, 1974

15.1 Euchaeta Philippi, 1843

Morphology:

PLC rounded, occasionally bearing a blunt papilla; Hd in lateral profile may show frontal prominence; Ro single, may be prominent. A2 rami subequal. Mxp large, stout and bearing large, curved distal setae adapted for raptorial feeding. P1,2 segmentation: 2-1 or 3-1.

FEMALE gnsgt with well developed ventral genital protuberance; may be asymmetrical in dorsal view; P5 absent (1).

MALE P5 large biramous and asymmetrical. Enp one-segmented, lft P5 bp swollen more than rt P5 bp (1).

The enlarged raptorial mxp separates this genus from all other local forms.

Comments:

Several authors (2, 3, 4, 5) have split this genus into two genera, Euchaeta and Pareuchaeta; however, we agree with Fontaine (6) and other authors (7, 8) who consider Pareuchaeta invalid, and place all species into the genus Euchaeta.

References:

1) Davis, 1949b
2) Brodsky, 1950
3) Tanaka, 1968
4) Tanaka and Omori, 1968
5) Evans, 1973
6) Fontaine, 1967
7) Vervoort, 1963
8) Park, 1978

15.1.1 Euchaeta californica Esterly, 1906

Synonymy:

Pareuchaeta californica: Brodsky (1950)
Euchaeta dubia: Esterly (1906)
Pareuchaeta dubia: Brodsky (1950)
NOT P. californica: Tanakà and Omori (1968)
NOT P. dubia: Tanaka and Omori (1968)
NOT Euchaeta dubia: Vervoort (1963)

Morphology:

PLC rounded, Hd rounded or acute in dorsal view, but in lateral view with a small frontal eminence; Ro well developed; A1 just exceeds Pro length; P1 exp1 with outer distal spine. P2 exp3 second outer spine arising from a lobe separated from the segment by a deep incision. Innermost seta of each CR naked and curving twice (1).

FEMALE TL 7.0-8.1 mm; Pro:Ur ratio about 3.5; Ro directed antero-ventrally; gnsgt symmetrical in dorsal view, swollen laterally in proximal half; genital protuberance large, confined to proximal half of gnsgt (1).

MALE TL 7.5 mm; Ro directed ventrally; P5 of complicated shape (1).

Size, the curved inner setae of the caudal rami, the symmetric gnsgt (in ventral view) of the female and the rounded or slightly angular PLC separate this species from all other local members of the genus.

Distribution and Occurrence:

Reported only from the type locality (coast of California) and northeastern Pacific (1). Locally, in Queen Charlotte Strait (2). Rare in the study area and likely an indicator of water of southern origin.

Life History:

Juveniles undescribed; however, Campbell (3) describes all life history stages of the closely related species E. elongata. The characters used in the key should allow identification of the CV and possibly the CIV.

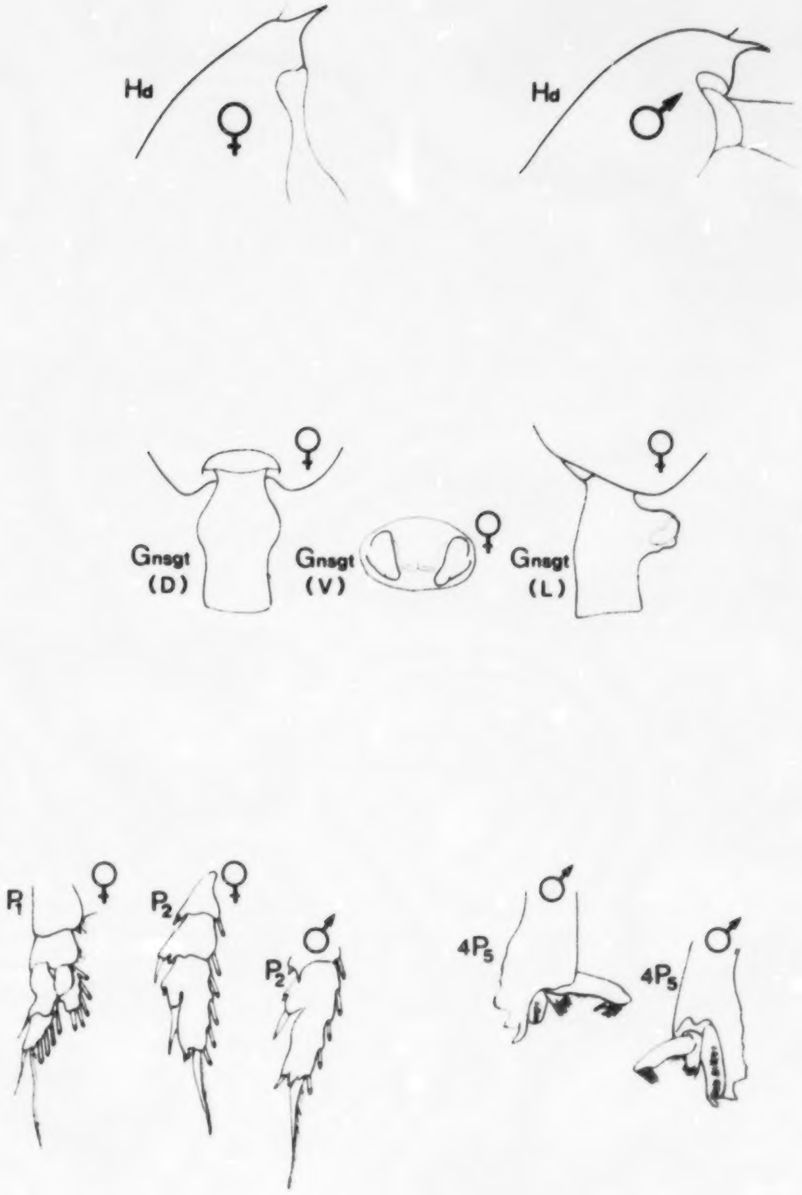
Comments:

This species has been misidentified on several occasions, in part due to the inadequate description of Esterly (4). Park (1) redescribes the species, indicates the synonymies, and considers that E. dubia represents the male of E. californica, which had previously been undescribed.

References:

1) Park, 1977
2) Stone, 1980
3) Campbell, 1934a
4) Esterly, 1906

15.1.1


Hd
♀
Hd
♂
♀
Gnsgt
(D)
Gnsgt
(V)
♀
♀
Gnsgt
(L)
P_1
♀
P_2
♀
P_2
♂
♂
$4P_5$
♂
$4P_5$

Euchaeta californica

from Park, 1977

15.1.2 *Euchaeta elongata* Esterly, 1913

Synonymy:

Euchaeta japonica: Marukawa (1921); Campbell (1929b, 1934a); Mori (1937); Davis (1949b); Cameron (1957); Fulton (1972)
Pareuchaeta japonica: Brodsky (1950); Shih et al. (1971)
P. elongata: Tanaka (1958); Tanaka and Omori (1968); Evans (1973)

Morphology:

PLC produced slightly as blunt processes; A1 short, just exceed Pro length; innermost setae of each CR naked and curved twice (1).

FEMALE TL 6.3-7.4 mm; gnsgt large, narrow proximally but with a large genital protuberance arising from middle of segment; ansgt reduced; P5 lacking; P1 exp two-segmented (1).

MALE TL 5.5-6.3 mm; PLC somewhat reduced; mouth parts much reduced; P1 exp three-segmented, exp1 lacking outer distal spine; P5 extremely large; rt bp2 enlarged, broadly rectangular; lft enp reduced, rudimentary; rt enp long and styliform (1).

Separable from all other members of the genus by knob-like processes of the PLC in the CV and CVI.

Distribution and Occurrence:

Widely distributed and locally abundant in the North Pacific. Evans (2) discusses the distributional ecology in British Columbia and adjacent waters.

Life History:

The life history and post-embryonic development of this species are fully described (1). Bright blue egg clusters are often attached to the gnsgt of adult females (convenient for bioassay and similar studies).

Total Length (mm):

CV	5.5	CII	2.4	NVI	0.83-0.90	NII	0.64-0.67
CIV	4.2	CII	1.8	NV	0.80	NII	0.63-0.65
		CI	1.2			NI	0.59

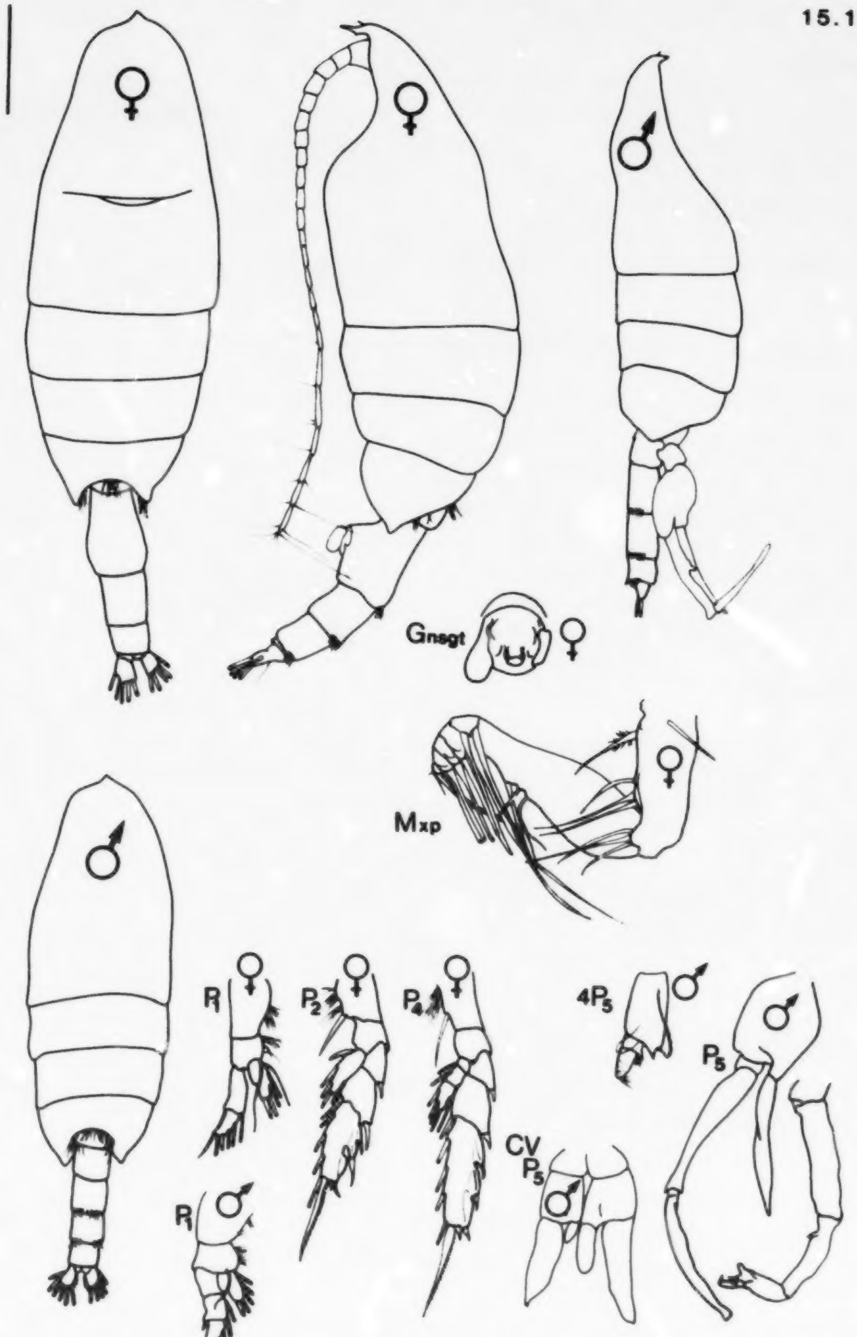
Comments:

The confusion in the taxonomy of the species is outlined by Evans (2). We accept the synonymy of *E. japonica* Marukawa with *P. elongata* Esterly which Evans also accepts.

References:

1) Campbell, 1934
2) Evans, 1973

15.1.2


♀
♀
♂
Gnsgt ♀
Mxp ♀
♂
P_1 ♀
P_2 ♀
P_4 ♀
$4P_5$ ♂
P_5 ♂
CV P_5 ♂
P_1 ♂

Euchaeta elongata

from Marukawa, 1921; Mori, 1937; Campbell, 1934

15.1.3 *Euchaeta media* Giesbrecht, 1888

Morphology:

PLC rounded or angular; Hd acute in dorsal view, in lateral view with a distinct frontal eminence; innermost seta of each CR naked and straight; A1 just exceed length Pro; P2 exp3 median outer spine just reaches base of following spine (1).

FEMALE TL 3.30-4.64 mm; gnsgt asymmetrical in dorsal view, in ventral view with process on lft lateral margin (1).

MALE TL 3.05-4.32 mm (1,2).

Separable from other local members of the genus by its relatively small size, the short median outer spine on the female P2 exp3, and the straightness of the setae on the inner edges of the caudal rami.

Distribution and Occurrence:

Common in the epiplankton of the tropical, subtropical and temperate zones of the world's oceans; Vervoort (2) summarizes the distribution. Locally, reported from Queen Charlotte Strait (3).

Life History:

Juveniles undescribed but should be similar in general form to those of *E. elongata* (4). The size and characteristic maxillipeds should allow the identification of the CV and possibly the CIV.

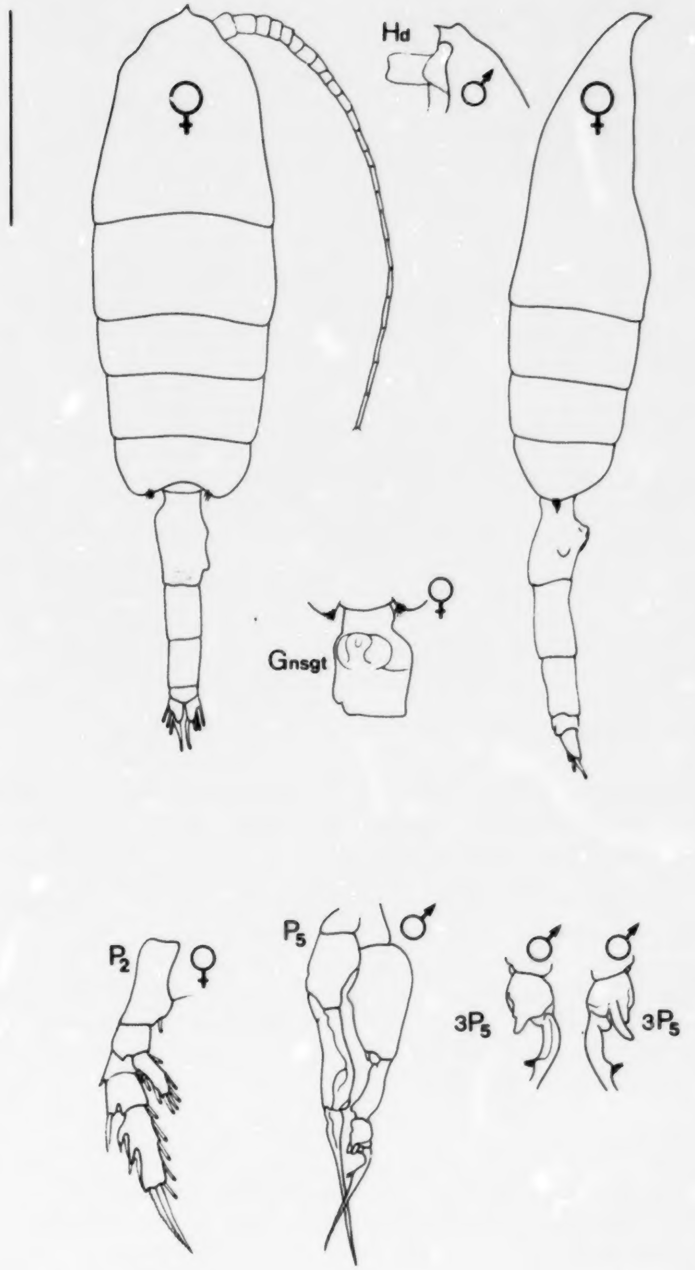
Comments:

Rare in the study area.

References:

1) Brodsky, 1950
2) Vervoort, 1963
3) Stone, 1980
4) Campbell, 1934a

15.1.3



♀
Hd
♂
♀
♀
Gnsgt
P_2
♀
P_5
♂
♂
♂
$3P_5$
$3P_5$

Euchaeta media

from Esterly, 1905; Owre and Foyo, 1967; Grice, 1961; Park, 1968

15.1.4 Euchaeta spinosa Giesbrecht, 1892

Synonymy:

Undeuchaeta major: Esterly (1905: male only)

Vervoort (1963) gives extensive references, and Park (1978) gives an up-to-date summary of the distribution of the species.

Morphology:

Hd apically acute, Ro elongate; P2 exp3 median outer seta elongate, reaches base of distal outer spine; PI expl with outer distal spine; innermost seta of each CR naked and straight; P3-P4 posterior surfaces spinulose(1, 2).

FEMALE TL 6.0-7.2 mm; Pro:Ur ratio about 2.6; gnsgt ventral protuberance arising in proximal half of gnsgt and flanked on either side by large plates; in ventral view, gnsgt strongly asymmetric, with large outgrowth on the lft side; in lateral view, genital flanges appear similar in shape; densely spinulose ventrally (1, 2).

MALE TL 6.1-6.9 mm (1, 3).

E. spinosa is characterized by the shape of the genital prominence in the female and the spinulation of the P3-P4 posterior surfaces in both sexes.

Distribution and Occurrence:

Widely distributed in the tropical, temperate and subtropical regions of the Atlantic, Pacific and Indian Oceans (4). Locally, reported near the Gulf Islands (2) and in Queen Charlotte Strait (6).

Life History:

Juveniles undescribed but should be similar in general form to those of E. elongata (7). Most of the characters used to identify this species are restricted to the adult; however, the spine on PI expl may help to separate juveniles of this species from those of similar species. In E. spinosa, this spine barely reaches the mid-point of PI exp2.

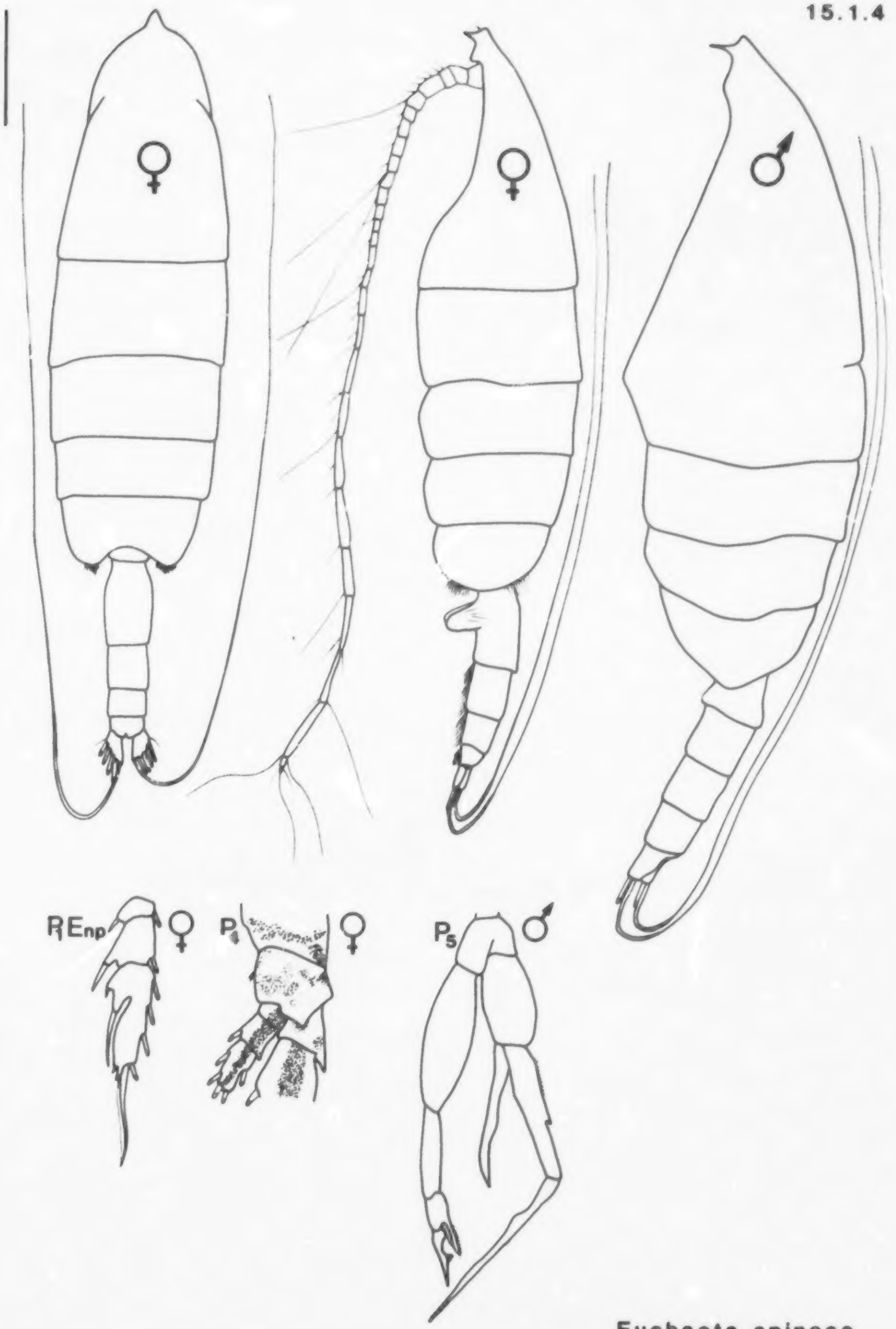
Comments:

Rare in the study area, but may be more numerous in offshore areas that have been little studied until recently (e.g. oceanic water on the west coast of Vancouver Island).

References:

1) Brodsky, 1950
2) Tanaka and Omori, 1968
3) Vervoort, 1963
4) Park, 1978
5) Wilson, 1950
6) Stone, 1980
7) Campbell, 1934a

15.1.4



Euchaeta spinosa

from Esterly, 1905; Sars, 1925; Owre and Foyo, 1967

16.1 Onchocalanus Sars, 1905

Morphology:

Pro elongate, ovoid; Hd rounded, occasionally cristate; Ur short, ansgt reduced; Ro strongly developed, with a heavily chitinized basal portion, and a bifurcate apical part terminating in two points or two fine filaments; PLC triangularly produced, pointed or rounded, but without projections. Al as long or longer than Pro; A2 rami subequal; max2 with enlarged, uncinate setae, giving appearance of a distal, curved claw; seven brush-shaped sensory appendages and one long, filiform sensory organ also found distally on max2. Pl,2 segmentation: 3-1/3-2; caudal surfaces of swimming legs spinose; Pl expl with spine; P2-P4 exp3 terminal spines large, serrate (1, 2).

FEMALE P5 uniramous, three-segmented, with two apical spines; caudal surface of P5 covered with strong hairs (1).

MALE P5 uniramous; rt P5 short, three-segmented; lft P5 elongate, five-segmented (1, 2).

The short Ur, angular PLC, heavily chitinized Ro and modified max2 separate this genus from all others.

References:

1) Vervoort, 1957
2) Vervoort, 1950

16.1.1 Onchocalanus magnus (Wolfenden, 1906)

Synonymy:

Xanthocalanus magnus: Wolfenden (1906)
X. similis: Esterly (1906)?
Onchocalanus frigidus: Wolfenden (1911)
O. affinis: With (1915)

Morphology:

FEMALE TL 5.2-8.8mm; Hd rounded in dorsal view; PLC acutely angled but without processes in lateral view; Ro present as a notched plate bearing two thin filaments; A1 reach just past PLC; max2 modified, armed with a large, nonserrate falciform spine. Swimming legs spinulose on posterior surface; P1 expl with outer distal spine, outer spines elongate; P5 uniramous, three-segmented and abundantly spinose (1).

MALE TL 5.2 mm; P5 uniramous, asymmetrical; lft P5 five-segmented, 5P5 setose; rt P5 two-segmented, total length shorter than lft 1P5 (2).

Distribution and Occurrence:

Recorded primarily from Antarctic waters, but found also in the North Atlantic and northwestern Pacific Oceans and near the coast of California (1). The temperate specimens seem to be near the bottom end of the size range while the Antarctic specimens are near the upper end. Locally, extremely rare, but recorded in samples from the Institute of Ocean Sciences collection.

Life History:

Juveniles undescribed; however, the CV and possibly CIV should be separable based on size, the max2 and the PLC.

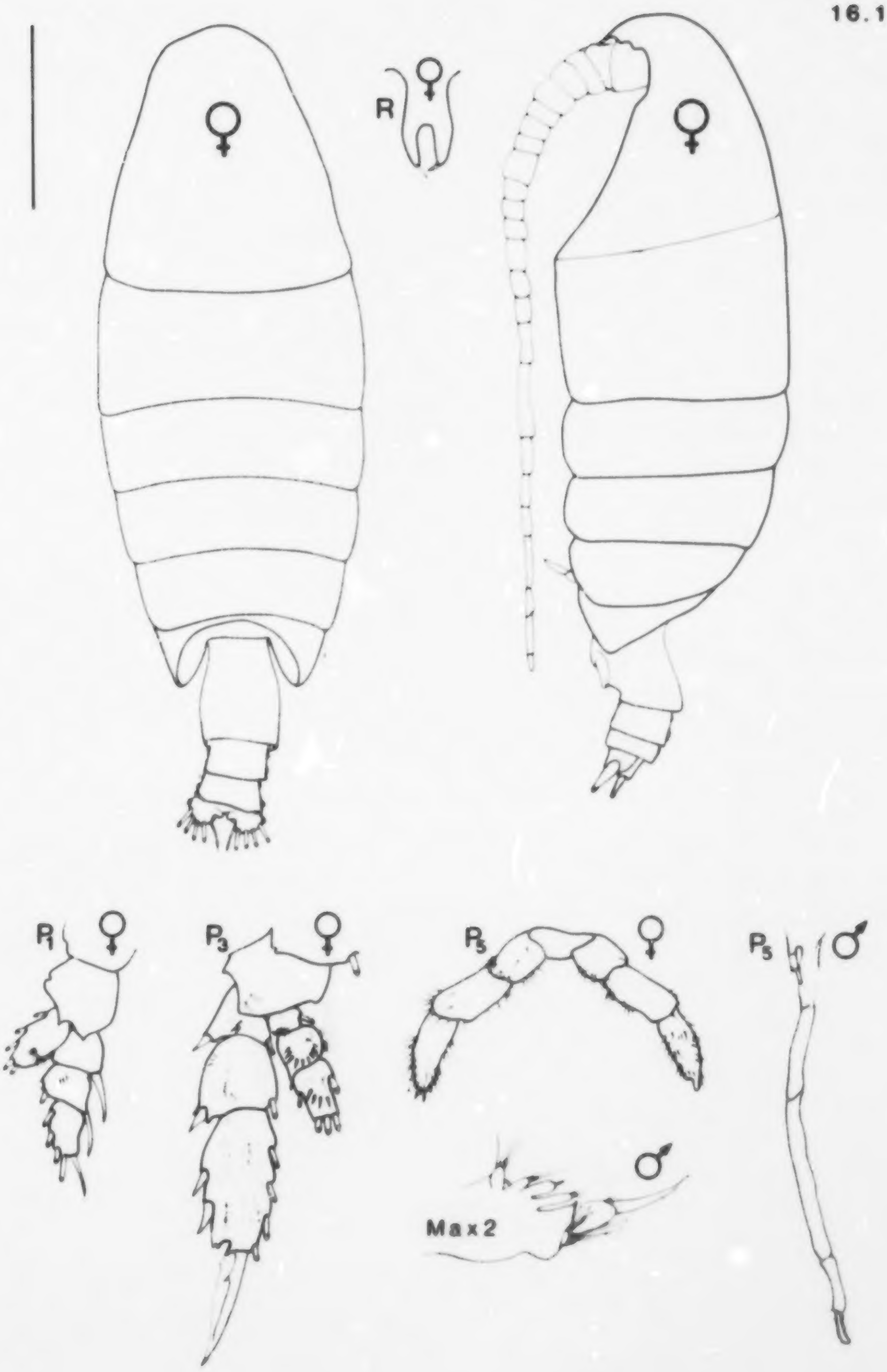
Comments:

Brodsky (1) suggests that Esterly's (3) Xanthocalanus similis was in fact a CV Onchocalanus magnus. Esterly's record is from California, and supports the idea of O. magnus being found in British Columbia waters; a re-examination of Esterly's type specimens is merited.

References:

1) Brodsky, 1950
2) Vervoort, 1957
3) Esterly, 1906

16.1.1


♀
R ♀
♀
P1 ♀
P3 ♀
P5 ♀
P5 ♂
♂
Max2

Onchocalanus magnus

from Vervoort, 1950, 1957; Brodsky, 1950

17.1 Scottocalanus Sars, 1905

Morphology:

Hd with triangular crest in lateral view; Ro massive, terminally bifurcate, with apices naked or bearing short processes; PLC usually produced backwards and acute; max2 bearing both vermiform and apically widened sensory setae. P1-P4 posterior surfaces with numerous, irregularly set spines; P1 exp1 with outer distal spine.

FEMALE P5 uniramous, incompletely segmented, with two to four segments, armed on distal inner margin with large, serrate seta directed backward.

MALE P5 massive, biramous; enp short; lft P5 rami subequal and similar; rt P5 exp longer than enp; lft P5 bp longer than rt P5 bp. P5 of same general structure as Lophothrix and Scaphocalanus, but more massive (1).

	Scottocalanus	Arietellus	Lophothrix
Ro massive	y	n	y
P1 exp1 spine	y	y	n
A2 exp longer than A2 enp	y	n	n
P1,2 segmentation	3-1/3-2	3-3/3-3	3-1/3-2
Number of large setae on fP5	1	-	3, 4

References:

1) Brodsky, 1950

17.1.1 Scottocalanus persecans (Giesbrecht, 1895)

Synonymy:

Scolecithrix persecans: Esterly (1905)

Morphology:

Pro robust; Hd cristate; PLC rounded and slightly produced posteriorly as broad flaps; Ro a strongly developed plate with a V-shaped incision reaching midlength of plate, the projection on either side of the incision armed with long, rostral filaments; A1 approximately equals TL; angst reduced and may not be visible (1).

FEMALE TL 3.9-4.6 mm; Pro:Ur ratio about 5.0; gnsgt almost ½ Ur; P5 reduced, uniramous; distal segment of P5 armed with an elongate spiniform seta which reaches near end Ur (1).

MALE TL 4.3-5.4 mm; Pro:Ur ratio about 2.6; P5 biramous, rt enp one-segmented, styliform and slightly longer than expl; lft bp elongate, lft enp one segmented and styliform, reaching midpoint of exp2 (1).

Distribution and Occurrence:

The past confusion of this species makes interpretation of historical records difficult. Vervoort (1) gives records from the Indo-Pacific, Celebes Sea, Flores Sea and Makassar Strait, all between 14° and 129° E longitude. He is suspicious of Esterly's (2) records from California. Locally, Stone (3) records the species from Queen Charlotte Strait.

Life History:

Juveniles undescribed; however, the large size, crest and massive rostrum should allow identification of this species in the CIV and CV. Note, however, the possibility of confusion with Lophothrix frontalis.

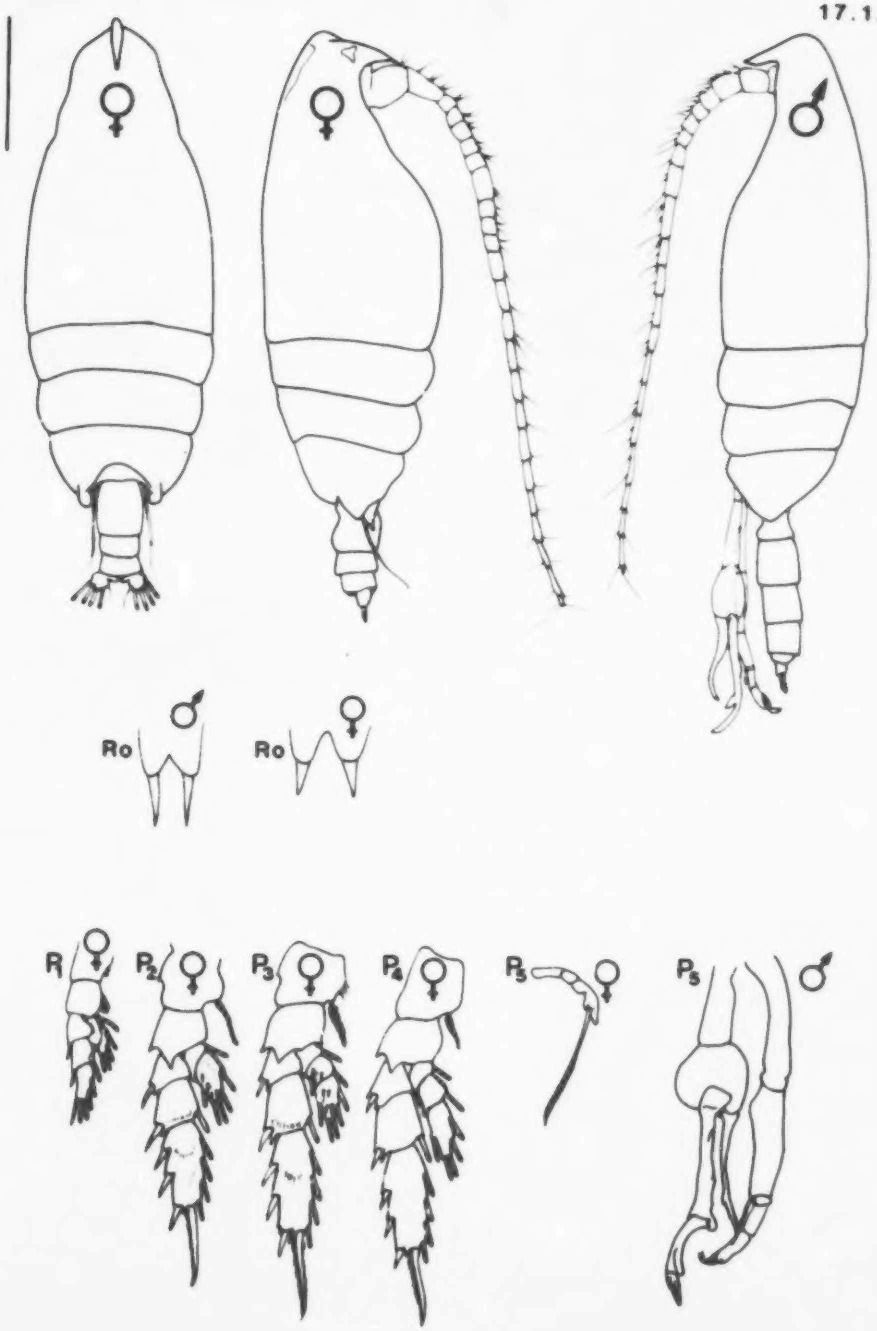
Comments:

Vervoort (1) suggests that many records of S. persecans, including Brodsky's (4), are in fact S. thori With. Morris (5), however, indicates that while Brodsky's figures are based on Sars' (6) drawing of S. thori (as S. persecans), Brodsky is clearly referring to Esterly's (2) valid record of S. persecans. The taxonomy of this genus should be revised. Vervoort (1) gives a good account of some of the problems which need to be resolved.

References:

1) Vervoort, 1965
2) Esterly, 1905
3) Stone, 1980
4) Brodsky, 1950
5) Morris, 1970
6) Sars, 1925

17.1.1


♀
♀
♂
Ro
♂
Ro
♀
P1 ♀
P2 ♀
P3 ♀
P4 ♀
P5 ♀
P5 ♂

Scottocalanus persecans

from Sars,1925; Vervoort,1965

17.2 Lophothrix Giesbrecht, 1895

Morphology:

Hd often cristate; PLC rounded or angular; Ro large, distally bifurcate but without spines, PI expl without outer distal spine (1).

FEMALE P5 with three or four conspicuous distal setae, the largest of which is on the inner margin (1).

MALE P5 thin, biramous, enp short; lft P5 rami subequal and similar; rt P5 exp longer than enp; lft P5 bp longer than rt P5 bp; P5 of same general structure as Scottocalanus and Scaphocalanus (1).

	Lophothrix	Scottocalanus	Arietellus
Ro massive	y	y	n
PI expl spine	n	y	y
A2 exp longer than A2 enp	n	y	n
P1,2 segmentation	3-1/3-2	3-1/3-2	3-3/3-3
Number of large setae on fP5	3,4	1	-

References:

1) Brodsky, 1950

17.2.1 Lophothrix frontalis Giesbrecht, 1895

Synonymy:

Scolecithrix frontalis: Esterly (1906)

Morphology:

PLC rounded, CR short.

FEMALE TL 4.75-7.4 mm; Pro:Ur ratio about 4.1; Hd cristate in dorsal view, Ro strongly bifurcate; gnsgt as long as wide, narrows proximally; Ur segments with fringe of five teeth along distal margin; A1 approximately equal to TL; P5 three-segmented, armed apically with three spines (1).

MALE TL 4.5-6.0 mm; Pro:Ur ratio about 2.7; Hd without crest, but highly arched in front; Ro of two long spines; ansgt much reduced; A1 extends to end Ur2; P5 biramous; rt P5 bp elongate; lft P5 bp2 widened; rami slender, styliform (1).

Distribution and Occurrence:

Widely distributed in the deep waters of all oceans. Vervoort (2) gives a detailed account of the distribution. Locally, reported in Queen Charlotte Strait (3).

Life History:

Juveniles undescribed; however, the characters used in the key should allow identification of the CV and possibly CIV.

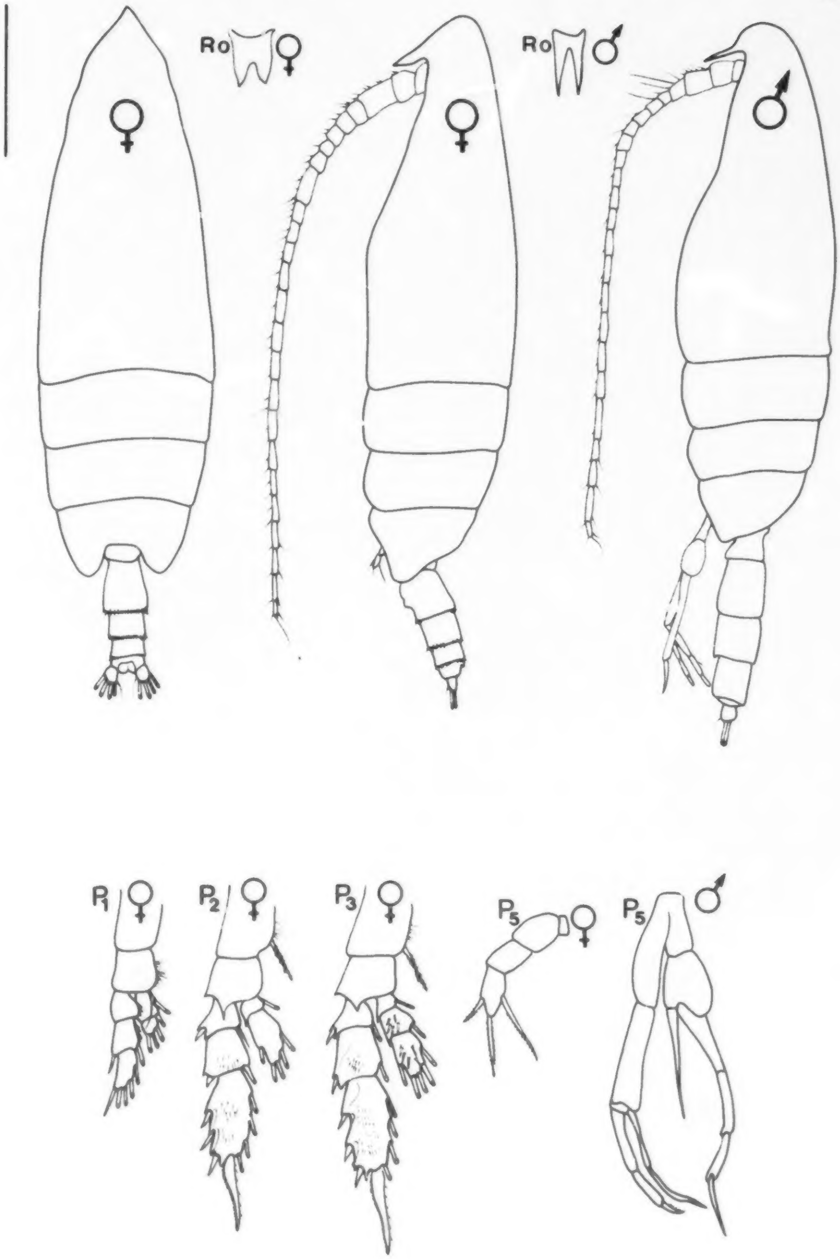
Comments:

Rare in the study area, and may indicate intrusions of equatorial water (4).

References:

1) Tanaka, 1961
2) Vervoort, 1965
3) Stone, 1980
4) Gardner, 1982a

17.2.1


Ro ♀
Ro ♂
♀
♀
♂
P1 ♀
P2 ♀
P3 ♀
P5 ♀
P5 ♂

Lophothrix frontalis

from Sars,1925

17.3 Scaphocalanus Sars, 1900

Morphology:

Ro with two thin, fairly long filaments; A2 rami subequal; max2 bearing vermiform and band-shaped sensory setae. PI expl lacking spine (1).

FEMALE Hd usually cristate; P5 with one to three segments, bearing a long inner spine and one to two apical spines (1).

MALE Hd usually not cristate. P5 long, thin, biramous, enp short; lft P5 rami subequal and similar; rt P5 exp longer than enp; lft P5 bp longer than rt P5 bp (1). P5 of same general structure as Scottocalanus and Lophothrix.

Hd without crest:	Scaphocalanus	Pleuromamma	Undeuchaeta	Scolecithricella
Ro	double	double	single	double
A2 rami subequal	y	?	n	n
PI expl spine	n	y	y	#

Hd with crest:	Scaphocalanus	Pleuromamma	Chirundina
PI expl with spine	n	y	y
AI with proximal denticles	n	y	n
A2 rami subequal	y	?	n

Comments:

Bradford (2) revises the family and redefines the genus. Copepods in this family should be carefully examined, as confusion can arise among the several closely related genera and species.

References:

1) Brodsky, 1950
2) Bradford, 1973

17.3.1 Scaphocalanus affinis (Sars, 1905)

Synonymy:

Amallophora affinis: Sars (1905)
A. gracilis: Wolfenden (1911)

Morphology:

PLC rounded or bluntly pointed; A1 approximately equal length Pro; A2 enp 1.4 x exp; max2 bearing vermiform and band-shaped setae; Ro of two long filaments (1, 2).

FEMALE TL 5.0-5.4 mm for Pacific specimens (in the Atlantic 3.6 mm (2)); Hd with low crest; Pro:Ur ratio about 3.0; P5 uniramous, three-segmented, distal segment bearing four spines; two very short outer marginal spines, one longer apical spine, and a very long inner marginal spine (1, 2).

MALE TL 4.5 mm for Pacific specimens (in the Atlantic 3.5 mm (2)); Hd lacking crest; Pro:Ur ratio about 2.6; P5 reaches distal margin Ur3; rt enp long, reaching distal margin lft bp2; lft enp two-segmented and longer than exp (1).

The males of S. affinis and S. magnus are difficult to separate; S. affinis is slightly larger, and has a more broadly rounded head.

Distribution and Occurrence:

Widely distributed in the deep waters of the Atlantic, Indian and Pacific Oceans (2). Locally, rare but recorded from samples in the Institute of Ocean Sciences collection.

Life History:

Undescribed; however, the size, crestate head and round PLC may allow separation of the CV from all other taxa except S. magnus.

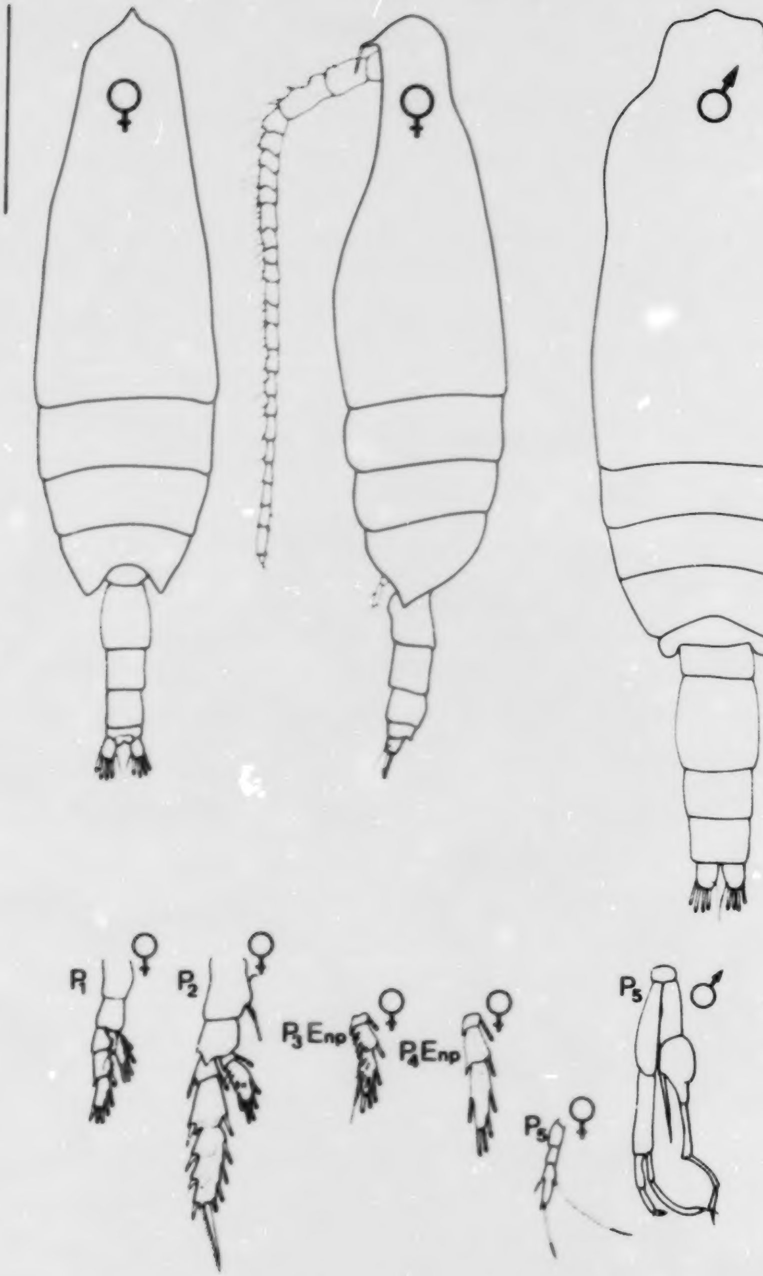
Comments:

The size difference between Atlantic and Pacific specimens is unusually large and should be further investigated. This family is complex, and must be examined with care to avoid confusion among the many closely related species and genera.

References:

1) Brodsky, 1950
2) Tanaka, 1961

17.3.1



♀
♀
♂
P1 ♀
P2 ♀
P3 Enp ♀
P4 Enp ♀
P5 ♀
P5 ♂

Scaphocalanus affinis

from Sars, 1925; Tanaka, 1961

17.3.2 Scaphocalanus brevicornis (Sars, 1900)

Synonymy:

Scolecithrix brevicornis: Sars (1900)
S. minutus: Tanaka (1937)
Amallophora brevicornis: Sars (1901)
A. impar: Wolfenden (1911)

Tanaka (1) and Vervoort (2) agree that Brodsky's (3) male S. brevicornis is actually S. elongatus. Tanaka (1) gives the first complete description of the male.

Morphology:

Hd and PLC rounded; Ro with an inflated base bearing two long filaments; A1 approximately equal length Pro; A2 enp 1.3 x exp; max2 bearing modified sensory setae on terminal lobes; P2 expl outer marginal spine long and curved, reaching beyond midpoint of exp2 (1).

FEMALE TL 1.9-2.7 mm; Pro:Ur ratio about 3.2; gnsgt slender, only slightly produced ventrally; P5 two-segmented, distal segment bearing one short outer marginal spine, one elongate apical spine, and one inner marginal spine about 1.5 x as long as the apical spine and denticulate along its distal margin (1).

MALE TL 2.2-3.0 mm; Pro:Ur ratio about 1.8; mid-dorsal suture on posterior 1/3 of cephalosome running parallel to the body axis; ansgt reduced; P5 reaches distal margin Ur2; lft P5 exp three-segmented, enp two-segmented; rt enp styliform (1).

Very similar to S. major, the only difference being a longer outer edge spine on the P2 expl.

Distribution and Occurrence:

Found deep in North Atlantic, Arctic, Antarctic and northwestern Pacific waters (1). Locally, reported as deep and rare in the Strait of Georgia (4).

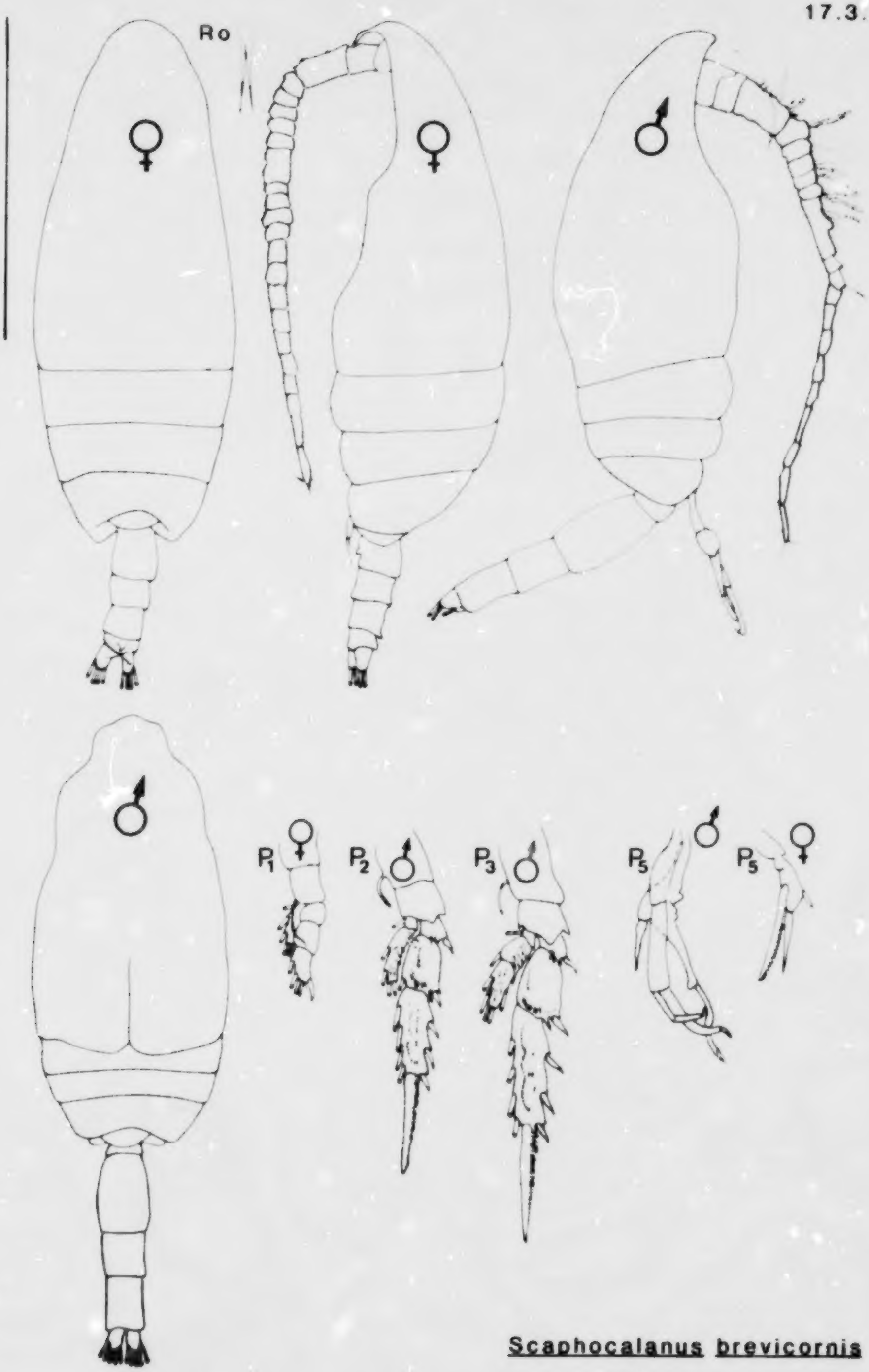
Life History:

Juveniles undescribed; however, the characters used in the key should allow separation of the CV.

References:

1) Tanaka, 1961
2) Vervoort, 1965
3) Brodsky, 1950
4) Fulton, 1972

17.3.2


Ro
♀
♀
♂
♂
P_1 ♀
P_2 ♂
P_3 ♂
P_5 ♂
P_5 ♀

Scaphocalanus brevicornis

from Koeller, 1974

17.3.3 Scaphocalanus echinatus Farran, 1905

Morphology:

PLC and Hd rounded; Ro with long, slender filaments; A2 exp 1.4 x enp; P2 expl with long, curved outer edge spine (1).

FEMALE TL 1.70-2.48 mm; Pro:Ur ratio about 3.8; P5 two-segmented; inner marginal spine 1.5 x as long as apical spine, and bearing about nine teeth along its distal margin (1).

MALE TL 1.26-1.34 mm; Pro:Ur ratio about 2.6; P5 extend to distal margin Ur4; rt exp three-segmented, distal segment reduced to a slender process; lft enp one-segmented (1).

Distribution and Occurrence:

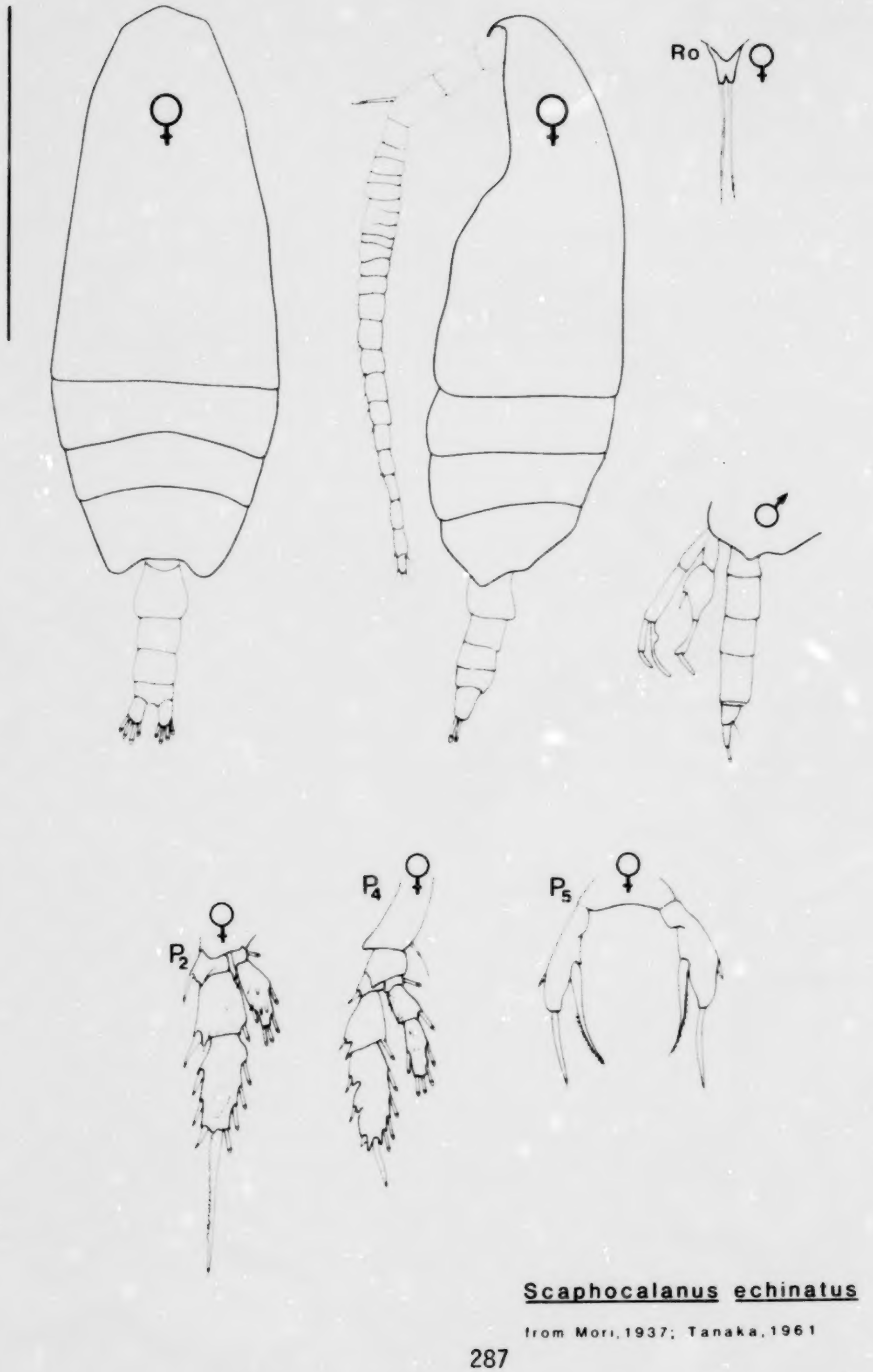
Recorded from the Atlantic, southern Pacific, and Sea of Japan (1). Locally reported as deep and common in the Strait of Georgia (2).

Life History:

Juveniles undescribed; however, the CV and perhaps the CIV should be separable using the characters in the key.

References:

1) Tanaka, 1961
2) Fulton, 1972



Scaphocalanus echinatus

from Mori, 1937; Tanaka, 1961

17.3.4 Scaphocalanus magnus (T. Scott, 1894)

Synonymy:

Amallophora magna: T. Scott (1894); Sars (1903)
Scolecithrix cristata: Giesbrecht (1895)
S. acrocephalus: Sars (1900)

Morphology:

PLC rounded or angular; Ro two slender filaments; A1 short; P1 expl bearing outer distal spine; P2-P4 anterior surfaces spinulose (1).

FEMALE TL 4.02-5.20 mm; Pro:Ur ratio 3.3; Hd cristate; A2 enp 1.4 x exp; gnsgt slender, barely protruding ventrally; P5 two-segmented, outer marginal spine reaches apex of segment; inner marginal spine elongate and spinulose (1).

MALE TL 4.55-5.0 mm; Pro:Ur ratio about 2.0; Hd obtusely rounded, not cristate; A2 rami subequal; P5 extend to distal margin Ur2, basic shape as in other members of the genus (1).

Very similar to S. affinis, but differs by being slightly smaller in the female, having a less broadly rounded head and only two segments in the female P5.

Distribution and Occurrence:

Widely distributed in the deep waters of the Atlantic, Indian, Pacific and polar oceans (1). Locally, reported in Queen Charlotte Strait (2) and also in samples collected from the study area by the Institute of Ocean Sciences.

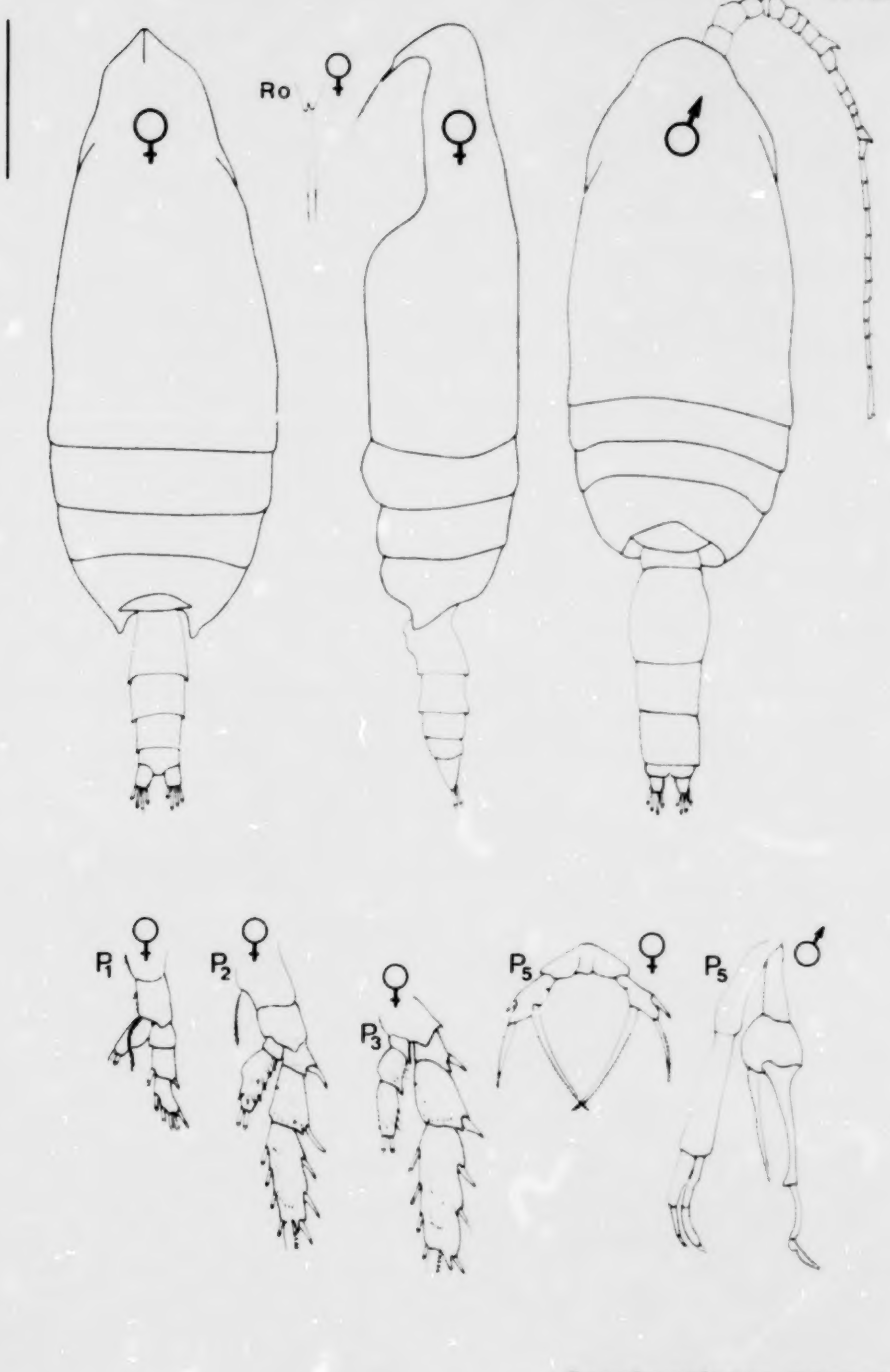
Life History:

Juveniles undescribed; however, the CV and possibly CIV should be separable, using the characters in the key, from all other taxa except S. affinis juveniles.

References:

1) Tanaka, 1961
2) Stone, 1980

17.3.4


Ro ♀
♀
♀
♂
P1 ♀
P2 ♀
P3 ♀
P5 ♀
P5 ♂

Scaphocalanus magnus

from Brodsky, 1950; Tanaka, 1961

17.3.5 Scaphocalanus major (T. Scott, 1894)

Synonymy:

Scaphocalanus medius: Sars (1925); Brodsky (1950)
Scolecithrix major: T. Scott (1894)
S. gracilipes: Farran (1908)
Amallophora media: Sars (1907)
A. dubia var. similis: T. Scott (1894)

Morphology:

Hd and PLC rounded; P2 expl outer distal spine slightly shorter than ½ length exp2; P2-P4 rami spinulose on posterior surface (1).

FEMALE TL 2.4-3.1 mm; Pro:Ur ratio about 3.2; P5 two-segmented, outer marginal spine minute, apical spine elongate, inner marginal spine about 2 x apical spine (1).

MALE TL 2.4-2.8 mm; Pro:Ur ratio about 1.9; ansgt much reduced P5 reach distal margin Ur2, lft enp two-segmented and slightly enlarged proximally (1).

Distribution and Occurrence:

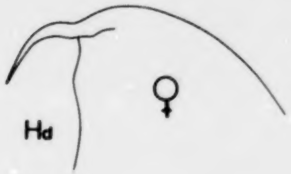
Widely distributed in the deep waters of the Atlantic, Indian and Pacific Oceans (1). Locally, recorded from samples taken in the study area by the Institute of Ocean Sciences, but quite rare.

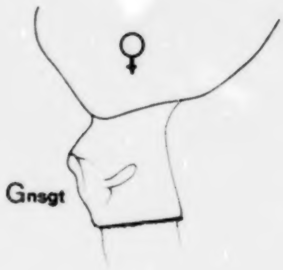
Life History:

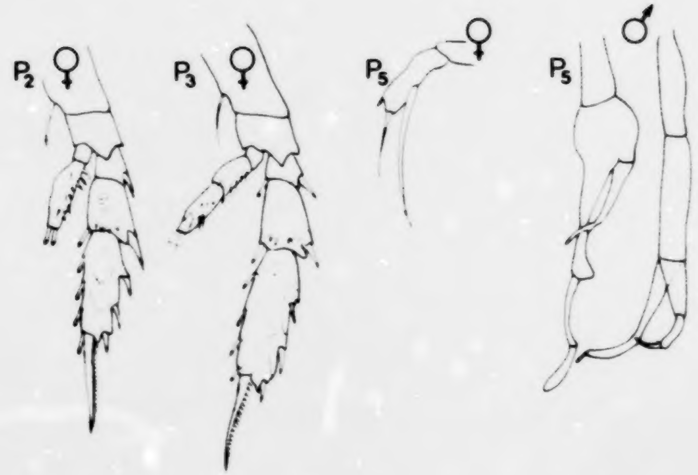
Juveniles undescribed; however, the CV and possibly CIV should be separable using the characters in the key.

References:

1) Tanaka, 1961







__Scaphocalanus__ __major__

from Tanaka, 1961

17.3.6 *Scaphocalanus subbrevicornis* (Wolfenden, 1911)

Synonymy:

Scolecithrix glacialis: Wolfenden (1911: male only)
Scaphocalanus gracilicaudatus: Tanaka (1937: male only)
S. macropes: Tanaka (1953)

Morphology:

PLC and Hd rounded, rostral filaments long, slender; P2 expl outer edge spine only about 1/3 length of outer margin of exp2; A2 rami subequal (1).

FEMALE TL 1.75-2.10 mm; Pro:Ur ratio about 3.2; gnsgt as long as wide; ventral protuberance slight; P5 two-segmented; inner marginal spine 1.8 x apical spine; other spines small and variable in number (1).

MALE TL 1.65-1.80 mm; Pro:Ur ratio about 2.1; P5 reach distal margin Ur3, similar in form to other members of the genus (1).

Distribution and Occurrence:

Widely distributed in deep waters of the Antarctic, Atlantic, Indian and Pacific Oceans (1). Locally, recorded from the Strait of Juan de Fuca (2).

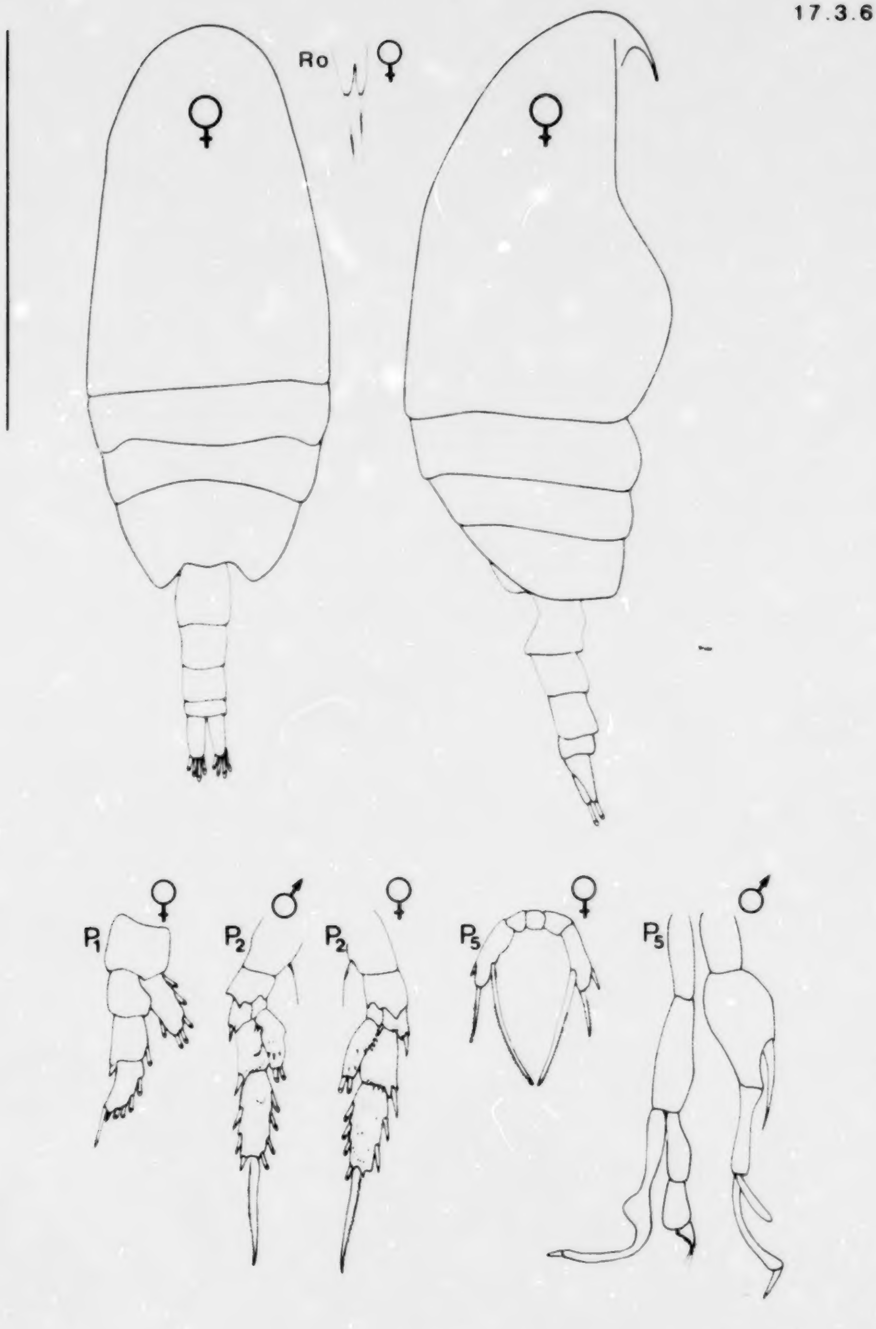
Life History:

Juveniles undescribed; however, the CV and possibly CIV should be separable using the characters in the key.

References:

1) Tanaka, 1961
2) Chester et al., 1980

17.3.6



Ro
♀
♀
♀
P1
♀
P2
♂
P2
♀
P5
♀
P5
♂

Scaphocalanus subbrevicornis

from Mori, 1937, Tanaka, 1961

17.4 Racovitzanus Giesbrecht, 1902

Morphology:

PLC rounded or angular; Ro large, single, sausage-shaped; PI expl without spine; max2 with band-shaped and vermiform sensory setae; AI just exceeding prosome (1).

FEMALE Gnsgt elongate, almost ½ length of Ur; CR diverging laterally. P5 uniramous, symmetrical, two-segmented, with elongate spine on inner distal margin (1, 2).

MALE P5 biramous and asymmetrical (1).

This genus is intermediate between Scaphocalanus and Scolecithrix, but differs from both in the characteristic structure of the rostrum, which is large, single and somewhat sausage-shaped.

References:

1) Brodsky, 1950
2) Tanaka, 1961

17.4.1 Racovitzanus antarcticus Giesbrecht, 1902

Morphology:

Ro a large, rotund process with a short terminal appendage (1).

FEMALE TL 2.1-2.42 mm; PLC slightly acute in profile; Pro:Ur ratio about 3.0; gnsgt elongate, exceeds combined length of Ur2 and Ur3; A1 just exceed Pro length; max2 bearing band-shaped and vermiform sensory setae. P5 two-segmented, bearing short apical spine and much longer inner spine, the latter serrate and equal to length of distal P5 segment (1).

MALE TL 2.18 mm; P5 biramous, elongate and asymmetrical (3).

The distinctive rostrum plus the presence of both band-shaped and vermiform sensory setae on the max2 differentiates R. antarcticus from other local species.

Distribution and Occurrence:

Found in the northern Pacific Ocean, Bering Sea, Sea of Okhotsk, and southern Indian and Pacific Oceans (1). Locally, deep and rare, but encountered in the Strait of Georgia (2) and occasionally present in protected waters to the north.

Life History:

Juveniles undescribed; however, at least the CV and CIV females should be separable on the basis of their rostrum.

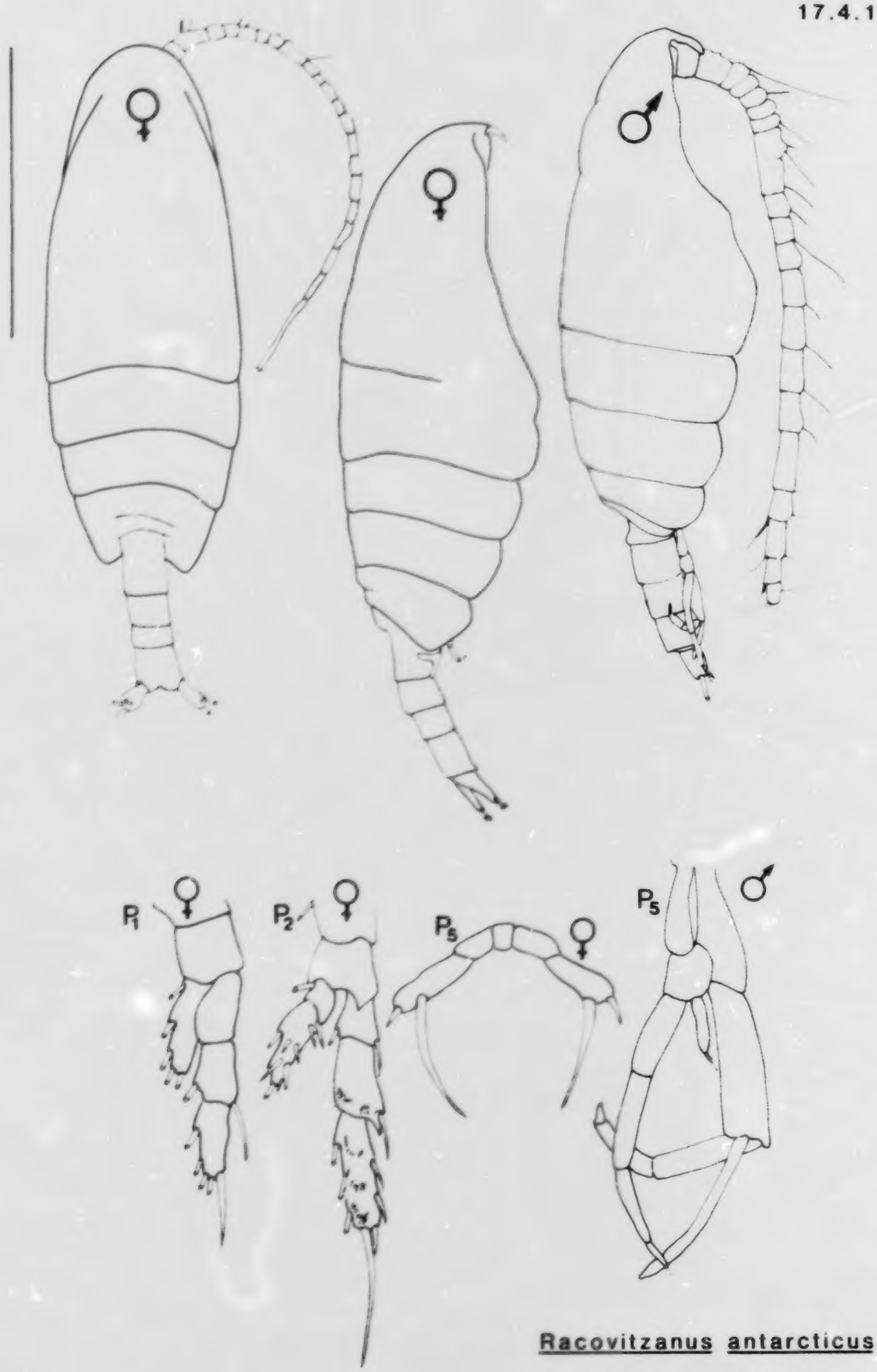
Comments:

The genus Racovitzanus is poorly defined and contains only one verified species, although others have been assigned to it. The genus is in need of revision.

References:

1) Brodsky, 1950
2) Fulton, 1972
3) Vervoort, 1957

17.4.1



Racovitzanus antarcticus

from Brodsky,1950;Vervoort,1957

17.5 Scolecithricella Sars, 1903

Synonymy:

Amallothrix Sars, 1925

Morphology:

Hd and PLC rounded; Pro short, wide; PI expl with or without spine. Ro bifurcate; AI usually longer than Pro, sometimes short; A2 exp longer than A2 enp; max2 usually with vermiform sensory setae, and occasionally with some bud-like setae. PI,2 segmentation: 3-1/3-2 (1, 2, 3).

FEMALE P5 uniramous, with one distinct spine and occasionally one or two smaller spines (1, 2, 3).

MALE P5 biramous, with enp reduced, and as long as or longer than Ur (1, 2, 3).

	Scolecithricella	Scaphocalanus	Microcalanus or Clausocalanus	Pseudocalanus
mP5 biramous	y	y	n	n
P2 with surface spination	y	y	n	n
A2 rami subequal	y	n	n	n
PI expl with outer edge spine	+	n	n	y

Comments:

All members of the genus Scolecithricella are similar and the key must be followed very carefully to assure proper identification. This genus should be revised. It should likely be split into more than one genus, but the variability of the characters make such a division difficult without access to extensive reference collections of type specimens.

References:

1) Brodsky, 1950
2) Tanaka, 1962
3) Mori, 1937

17.5.1 Scolecithricella emarginata (Farran, 1905)

Synonymy:

Scolecithricella obtusifrons: Sars (1909)?; A. Scott (1909); Bigelow (1926)
Scolecithrix emarginata: Farran (1926)
S. obtusifrons: Farran (1908); van Breemen (1908)?; A Scott (1909)
S. aequalis: Wolfenden (1911)
?S. atlantica: Wolfenden (1904); van Breemen (1908)
S. inornata: Esterly (1906)
Amallothrix emarginata: Sars (1925); Rose (1933); Bradford (1973)
A. inornata: Brodsky (1950)
Amallophora obtusifrons: Pearson (1906)
Scaphocalanus obtusifrons: With (1915)

Morphology:

Hd and PLC rounded; A1 exceed TL; A2 exp 1.2 x enp; Ro a small basal plate bearing two robust filaments; ansgt reduced and difficult to see; Plexpl with spine (1).

FEMALE TL 3.65-4.73 mm; Pro:Ur ratio about 4.7; P5 two-segmented, elongate and rectangular; distal segment bearing two spines near the apex (this character variable) (1).

MALE TL 3.60-4.00 mm; Pro:Ur ratio about 2.7; P5 slender, lft bpl,2 much elongate, bearing two subequal rami, rt P5 reduced, shorter than lft (1, 2).

Distribution and Occurrence:

The diverse synonymies confuse distributional records; however, the species appears to be fairly common in the deep waters of the North Atlantic and is also recorded from the Indo-Pacific, Arabian Sea, Sea of Japan, north-eastern Pacific and Pacific coast of North America (3). Locally, it has been recorded as Amallothrix inornata (4).

Life History:

Juveniles undescribed, key valid for adults only.

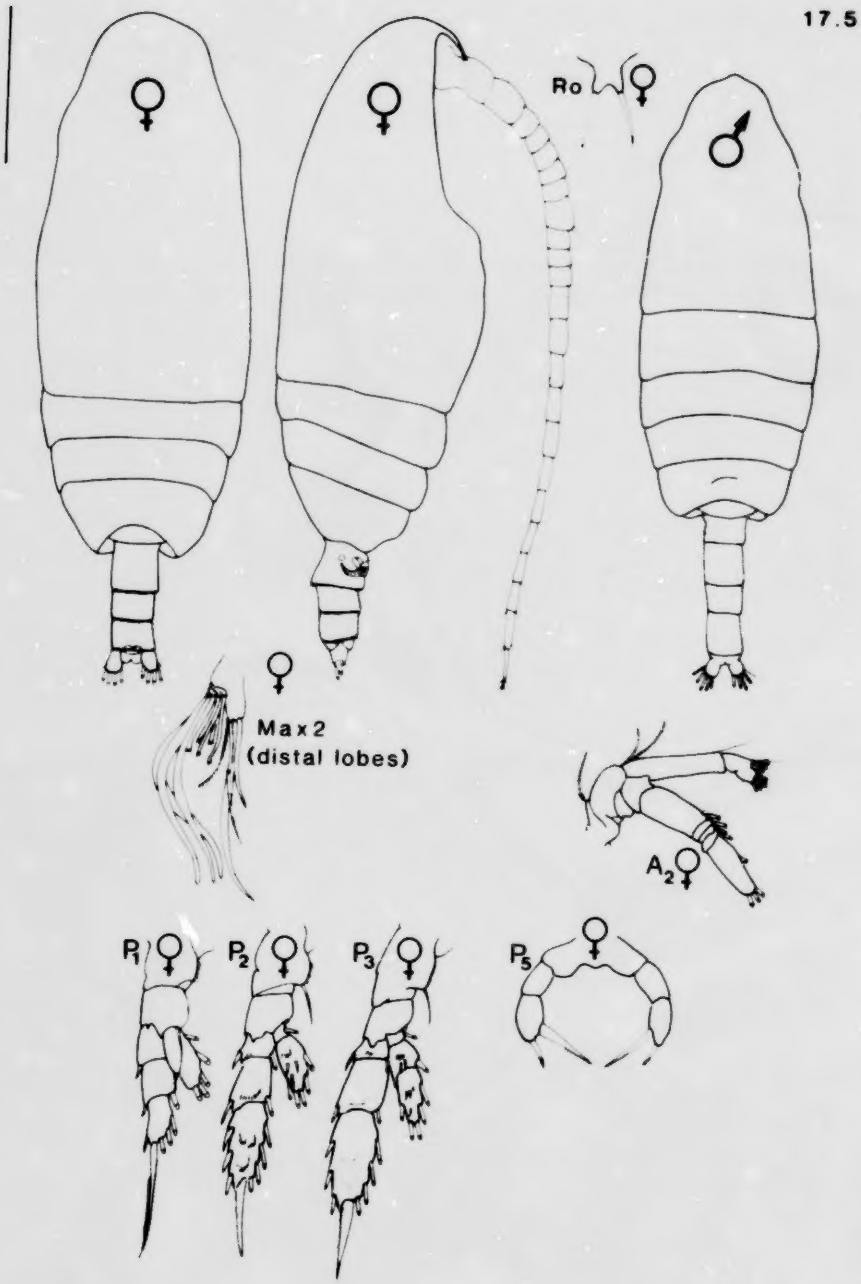
Comments:

Bradford (5) revises the family Scolecithricidae and redefines some of the genera. She places this species in the genus Amallothrix Sars, 1925. Although the status of these genera is still to be resolved, we follow Tanaka (1) and Vervoort (3) in placing this species in the genus Scolecithricella.

References:

1) Tanaka, 1962
2) Brodsky, 1950
3) Vervoort, 1965
4) Chester et al., 1980
5) Bradford, 1973

17.5.1


♀
♀
Ro ♀
♂
♀
Max 2
(distal lobes)
A_2 ♀
P_1 ♀
P_2 ♀
P_3 ♀
P_5 ♀

Scolecithricella emarginata

from Park, 1980; Tanaka, 1962

17.5.2 Scolecithricella minor (Brady, 1883)

Synonymy:

Scolecithrix minor: Cameron (1957)
S. roemeri: Mrazek (1902)

Morphology:

Hd and PLC rounded; Hd apex very convex in lateral view; AI less than TL; Ro in form of bifurcate plate with acute rami but bearing no filaments; PI expl lacking spine (1).

FEMALE TL 1.25-1.40 mm; Ur narrow; Pro:Ur ratio about 4.0; P5 one-segmented, broad, only slightly narrowed proximally, bearing short apical spine and elongate inner marginal spine (1).

MALE TL 1.20-1.40 mm; P5 exceed length Ur; lft P5 enp reduced, elongate; lft exp3 long and acute; rt enp rudimentary (1).

Distribution and Occurrence:

Widely distributed in all of the world's oceans (2). Locally, common in the Strait of Georgia and found throughout the study area (3).

Life History:

Juveniles undescribed. The presence of only two outer edge spines on the PIexp might allow juveniles of S. minor to be separated from other members of the genus.

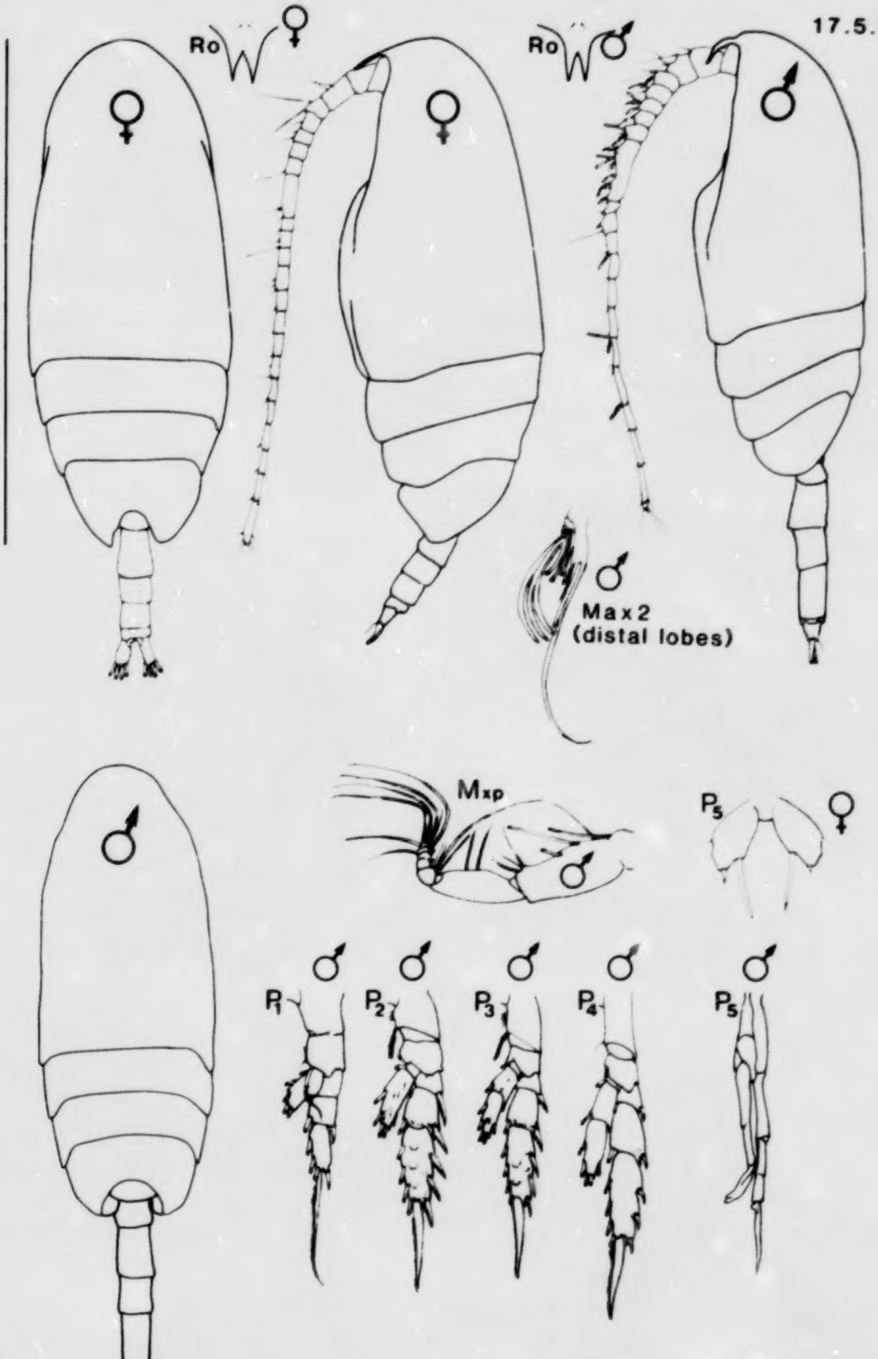
Comments:

Brodsky (1) separates this species into two varieties, one of which, S. minor var. orientalis, occurs in the northern Pacific, Sea of Japan, Sea of Okhotsk and Bering Sea. The local species conforms to this variety.

References:

1) Brodsky, 1950
2) Vervoort, 1965
3) Fulton, 1972

17.5.2


Ro
♀
Ro
♂
♀
♀
♂
♂
Max2
(distal lobes)
♂
Mxp
♂
P5
♀
♂
♂
♂
♂
♂
P1
P2
P3
P4
P5

Scolecithricella minor

from Park, 1[illegible]

17.5.3 Scolecithricella subdentata (Esterly, 1905)

Morphology:

FEMALE TL 1.4-2.2 mm; AI shorter than Pro; max2 bearing vermiform setae; PI expl with outer distal spine; P5 one-segmented, narrowing gradually towards base; apical spine reduced, inner marginal seta situated closer to distal end (1).

MALE Undescribed.

Similar to other members of the genus, but with relatively short AI and with fP5 only slightly narrowed proximally. As with all other members of this complex family, S. subdentata must be identified with care.

Distribution and Occurrence:

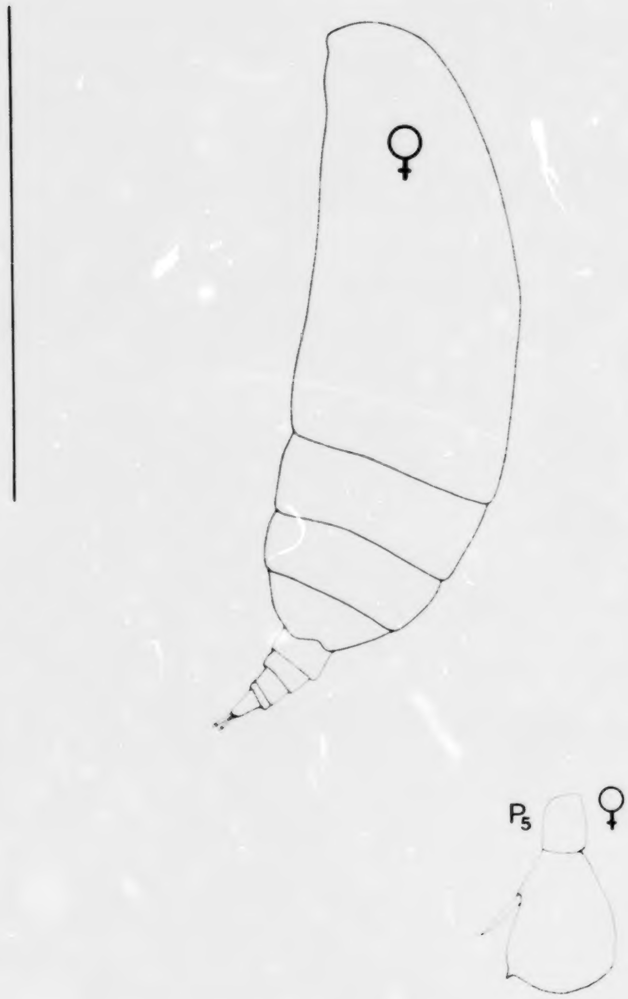
Recorded from the coast of California (2). Locally, reported as rare in the Strait of Georgia (3).

Life History:

Juveniles undescribed, key valid for adults only.

References:

1) Brodsky, 1950
2) Esterly, 1905
3) Fulton, 1972



Scolecithricella subdentata

from Esterly, 1905

17.5.4 Scolecithricella ovata (Farran, 1905)

Morphology:

Hd and PLC rounded; Ro a divergent base bearing strong spines; CR short; Al just less than TL; A2 exp 1.4-1.5 x enp; max2 bearing modified sensory setae (1).

FEMALE TL 1.80-2.20 mm; Pro:Ur ratio about 4.6; gnsgt as long as wide; P5 two-segmented, distal segment strongly narrowed towards base, bearing short inner marginal seta and occasionally a minute apical seta (1).

MALE TL 1.59 mm; Pro:Ur ratio about 2.5; ansgt reduced; P5 reaches ansgt; rt P5 four-segmented and very short, lft P5 five-segmented and much longer (1).

Separable from other members of the genus by the short rt mP5 and the proximally narrowed fP5. The similarity among members of this family requires that extra care be taken in their identification.

Distribution and Occurrence:

North Pacific, North and South Atlantic Oceans and Antarctic waters (1, 2). Locally, recorded in Queen Charlotte Strait (3).

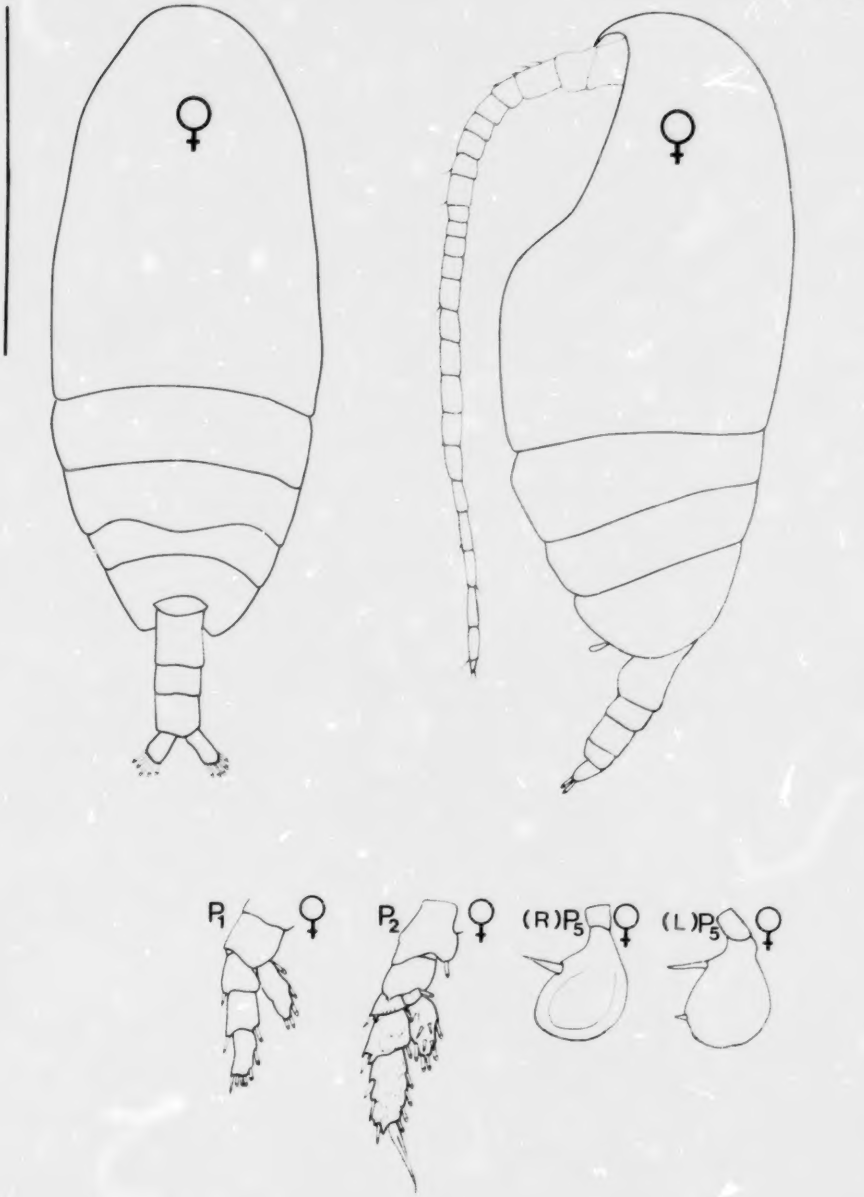
Life History:

Juveniles undescribed, key valid for adults only.

References:

1) Brodsky, 1950
2) Tanaka, 1962
3) Stone, 1980

17.5.4


♀
♀
P1 ♀
P2 ♀
(R)P5 ♀
(L)P5 ♀

Scolecithricella ovata

from Brodsky, 1950; Park, 1968

18.1 Tharybis Sars, 1902

Morphology:

Pro short, broad; PLC rounded; Ur and CR short; Ro with rounded, knob-like basal portion bearing two long filaments; A2 exp much longer than A2 enp; mxp2 swollen, greatest thickness at midlength. P1 exp1 bearing elongate spine at outer distal corner; P1-P4 usually without surface spinules; P2-P4 terminal spines serrate (1, 2).

FEMALE P5 uniramous (1, 2).

MALE P5 biramous (1, 2).

	Tharybis	Scolecithricella	Clausocalanus
P2-P4 with surface spination	n	y	n
A2 rami subequal	n	y	n
P1 exp 1 with outer edge spine	y	+	n

References:

1) Fleminger, 1957
2) Park, 1967b

18.1.1 Tharybis fultoni Park, 1967

Morphology:

Robust body; rounded PLC which are extended posteriorly; rounded head profile; short A1 (1).

FEMALE TL 1.25-1.31 mm; P5 with exceptionally large distal spines (1).

MALE TL 1.09-1.12 mm; lft 3P5 with both a falciform and a small triangular process (1).

Distribution and Occurrence:

Reported from the type location, the Strait of Georgia, where it is uncommon and deep (2) and from Strait of Juan de Fuca (3).

Life History:

Juveniles undescribed; key valid for adults only.

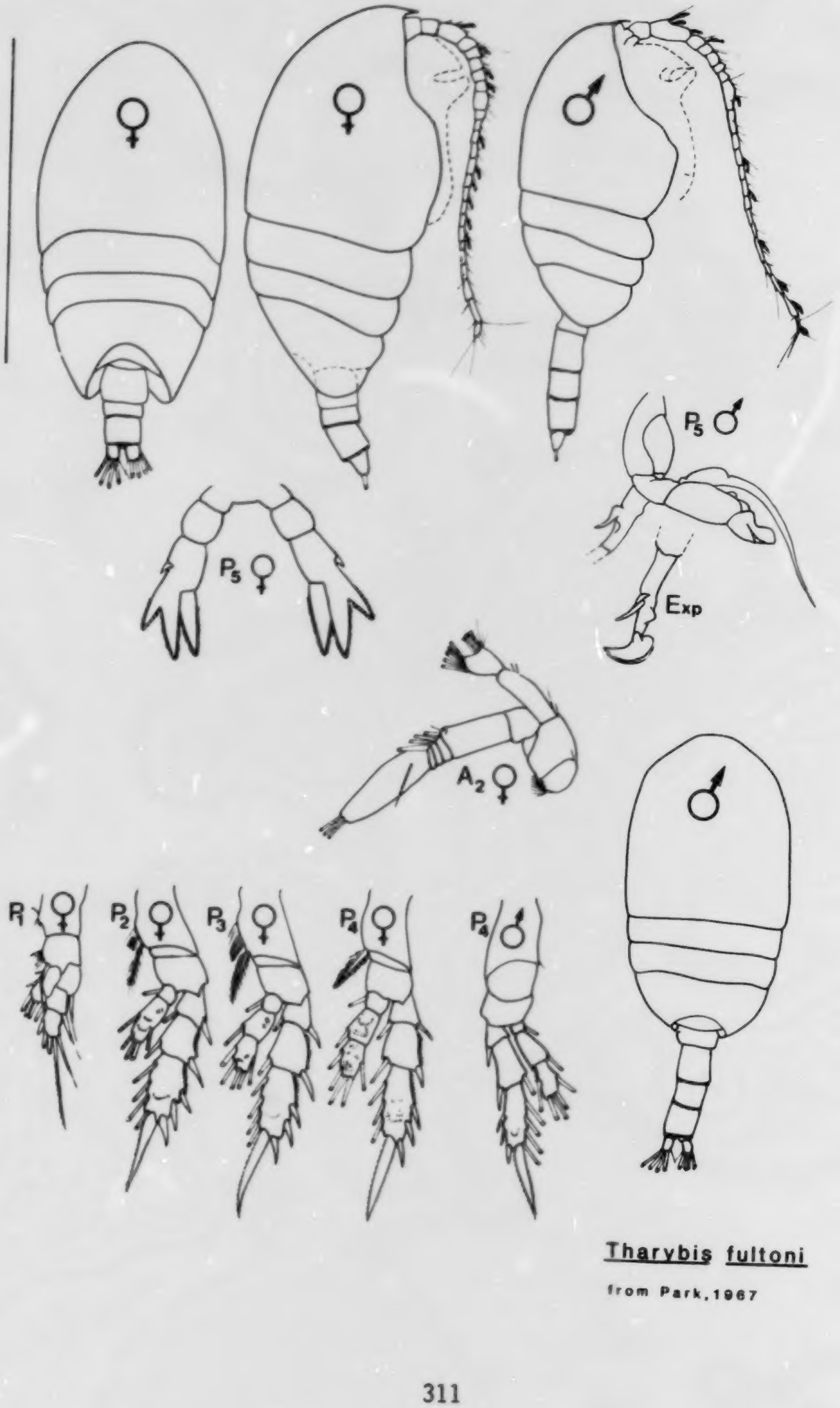
Comments:

Tharybis fultoni is the only local member of the genus.

References:

1) Park, 1967b
2) Fulton, 1972
3) Frost, pers. comm.

18.1.1


♀
♀
♂
P5 ♂
P5 ♀
Exp
A2 ♀
♂
P1 ♀
P2 ♀
P3 ♀
P4 ♀
P4 ♂

Tharybis fultoni

from Park, 1967

19.1 Eurytemora Giesbrecht, 1898

Morphology:

Hd rounded, Ro with two small filaments; thorax five-segmented; Ur and CR elongate. P1-P4 segmentation: 3-1/3-2/3-2/3-2 (1).

FEMALE PLC with large, pterygoid processes; Ur three-segmented; A1 symmetrical. P5 uniramous, usually symmetrical, four-segmented. 3P5 bearing large inner process on distal margin (1).

MALE PLC rounded; Ur four- or five-segmented. A1 asymmetrical, rt A1 geniculate. P5 uniramous, asymmetrical; lft P5 four-segmented, rt P5 four or five-segmented with long, curved distal segment (1).

Separated from all other local genera by the elongate Ur and, in the females, by the pterygoid processes and, in the males, by the geniculate A1 and distinctive P5.

References:

1) Brodsky, 1950

19.1.1 *Eurytemora affinis* (Poppe, 1880)

Synonymy:

Eurytemora hirundoides: Nordquist (1888); Campbell (1929b); Davis (1943); Brodsky (1950); Cameron (1957); Legare (1957); Fulton (1968, 1972).

Morphology:

FEMALE TL 1.48-1.71 mm; PLC armed with large pterygoid processes; gnsgt sharply narrowed distally; ansgt longer than gnsgt; ansgt and CR spinulose; 4P5 apical spine smooth, much longer than outer distal spine of same segment; 3P5 with inner distal corner extended onto an acute process (1).

MALE TL 1.40-1.65 mm; PLC rounded; P5 uniramous, four-segmented; rt mP5 distal segment swollen proximally; lft mP5 widened apically, with two processes separated by a depression (1).

Separable from the other members of the genus in the male by the extreme apical widening of the lft 4P5; the female is separable based on the spinulose ansgt and CR, and the lack of denticulations on the inner process of the 3P5.

Distribution and Occurrence:

Baltic Sea, northeastern and northwestern Atlantic, and northeastern Pacific (1). Locally, reported as common in the Strait of Georgia (2) and near the Queen Charlotte Islands (3).

Life History:

All stages, including nauplii, have been well-described (4); however, the lack of comparable complete descriptions for the other two local members of the genus restricts the applicability of the key to the adult only.

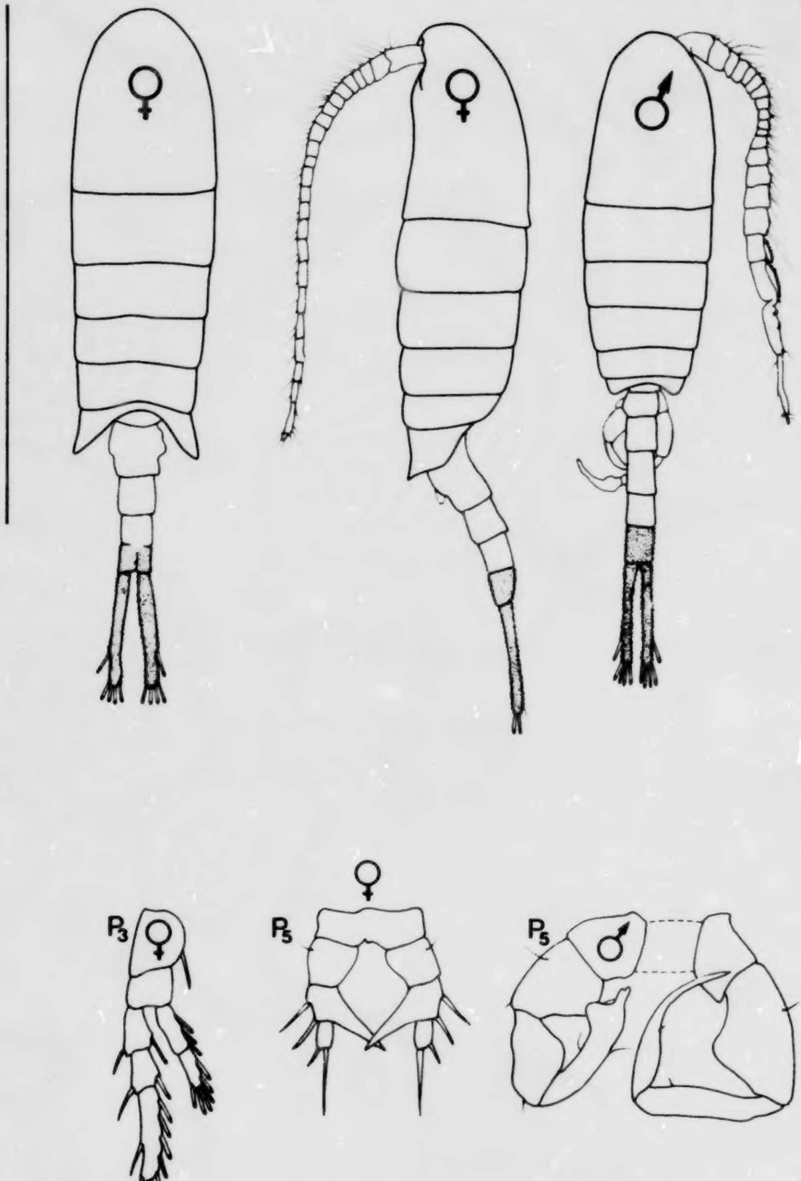
Total Length (mm):

fCV	1.26-1.53	NVI	0.30-0.37
mCV	1.14-1.29	NV	0.24-0.26
fCIV	1.04-1.22	NIV	0.20-0.22
mCIV	0.85-0.99	NIII	0.15-0.18
CIII	0.83-0.93	NII	0.13-0.15
CII	0.56-0.67	NI	0.09-0.10
CI	0.44-0.55		

References:

1) Brodsky, 1950
2) Fulton, 1972
3) Cameron, 1957
4) Davis, 1943

19.1.1



Eurytemora affinis

from Sars, 1903

19.1.2 Eurytemora americana Williams, 1906

Synonymy:

Eurytemora thompsoni: Willey (1923); Brodsky (1950)
E. transversalis: Campbell (1930); Brodsky (1950)
E. kieferi: Brodsky (1950)

Morphology:

Elongate Ur and CR (1).

FEMALE TL 1.20-1.58 mm; Posterior thoracic segment shortened, with pterygoid processes. CR spinulose. 3P5 expl with smooth inner process, distal segment with subequal apical spines (1).

MALE TL 1.22-1.43 mm; CR not spinulose, PLC without projections. P5 uniramous, rt 2P5 with swelling on inner edge, rt 3P5 long and slender, 4P5 falcate, inner margin irregular, with small spines. Lft 2P5 with proximal swelling, distal segment slightly dilated, bearing distally a bulbous expansion armed with two small spines (1).

Similar to the other local members of the genus, E. affinis and E. pacifica, but female with spinulose CR, smooth 3P5 inner process and terminal apical spines subequal in the P5. Male distinguished by proximal swelling of lft 2P5, and shape of distal segment of lft P5.

Distribution and Occurrence:

In the Atlantic, from Narragansett Bay to Ungava Bay, the northern Icelandic coast and southern British coast. In the Pacific, along the eastern edge from San Juan Island northward to Point Barrow, in the western Bering Sea and Sea of Okhotsk (1).

Life History:

All nauplii and copepodite stages have been briefly described and illustrated from laboratory reared specimens (2). CV males have a four-segmented Ur as opposed to the three-segmented Ur of the CV females.

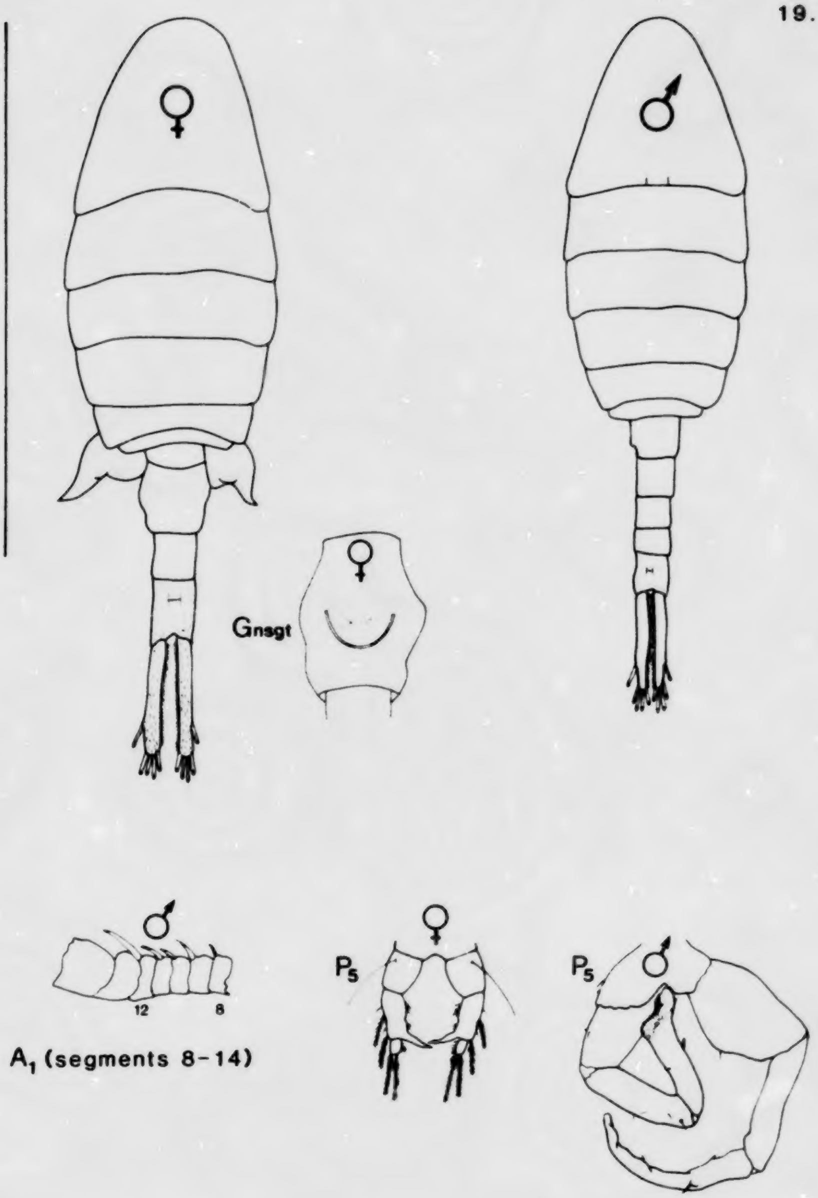
Total Length (mm):

CV	1.04-1.18	NVI	0.36
CIV	0.88-0.98	NV	0.30-0.31
CIII	0.74-0.84	NIV	0.24-0.26
CII	0.62-0.68	NIII	0.20
CI	0.56-0.59	NII	0.16-0.18
		NI	0.12

References:

1) Heron, 1963
2) Grice, 1971

19.1.2


♀
♂
♀
Gnsgt
♂
12
8
A₁ (segments 8-14)
♀
P₅
♂
P₅

Eurytemora americana

from Heron, 1963

19.1.3 Eurytemora pacifica Sato, 1913

Synonymy:

Eurytemora johanseni: Willey (1920); Davis (1949b); Brodsky (1950); Legare (1957)

Morphology:

Both males and females exhibit some degree of asymmetry (1).

FEMALE TL 0.99-1.30; PLC with pterygoid processes; Ur with three segments of approximately equal length;gnsgt greatly expanded laterally; CR long, but shorter than in other members of the genus, and naked; gnsgt and Ur2 each armed with two short bristles on each side. P5 asymmetrical uniramous, four-segmented; 3P5 bearing two outer spines and an acute denticulated process arising from the inner distal corner; 4P5 with long apical spine and single lateral spine. Asymmetry: apical spine of left leg much larger than that of right (1).

MALE TL 1.03-1.12 mm; PLC rounded; Ur five-segmented; P5 asymmetrical, uniramous, four-segmented; lft P5 distal segment club-shaped, 2P5 greatly widened medially; rt P5 distal segment narrow and curving (1).

Separable from other local members of the genus in the female by the lack of spinulation on the gnsgt and CR, and the denticulation of the inner process of P5 expl. The male is separable by the club-like shape of the lft P5.

Distribution and Occurrence:

Reported from the Sea of Japan, northern Alaskan coast, Bering Sea and Sea of Okhotsk (1). Locally, reported from the Strait of Georgia (2).

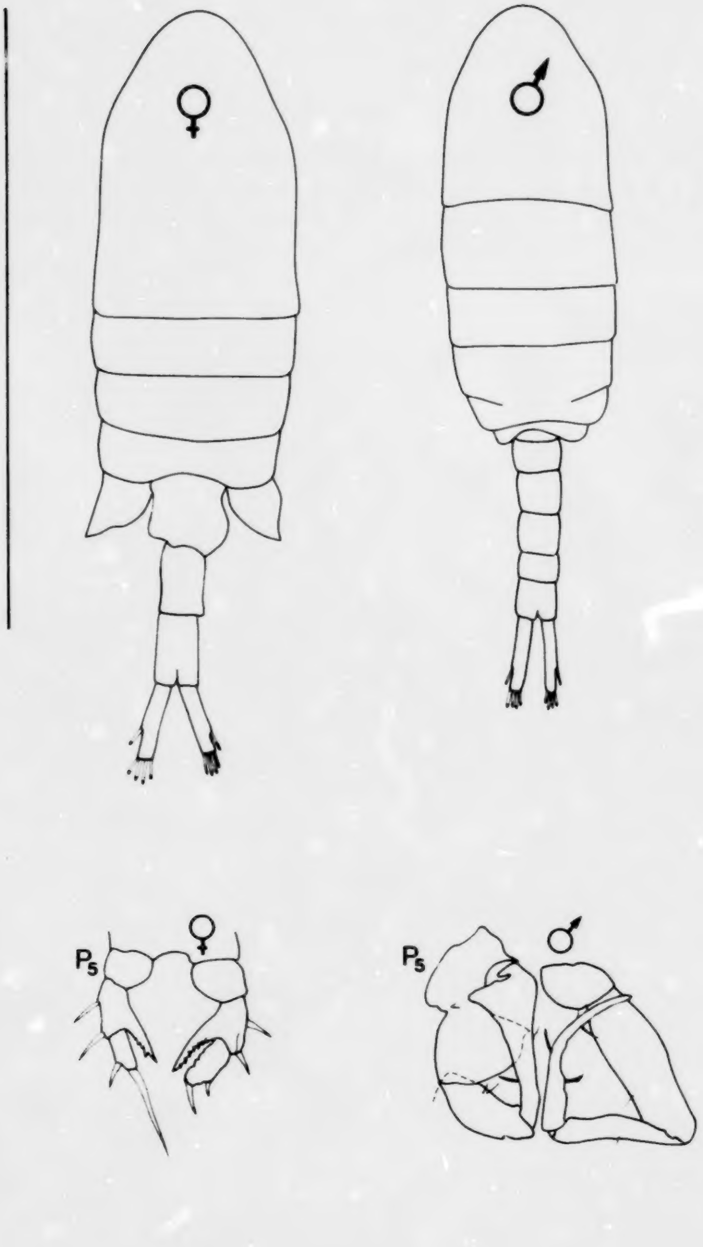
Life History:

Juveniles undescribed but those of Eurytemora affinis have been described and figured in detail (3).

References:

1) Brodsky, 1950
2) Legare, 1957
3) Davis, 1943

19.1.3



Eurytemora pacifica

from Brodsky, 1948

20.1 *Metridia* Boeck, 1864

Morphology:

Hd rounded; PLC rounded, occasionally with small, blunt papilla; Ur elongate; CR thin, sometimes long; terminal Ur segment with elongated posterior corners; A1 short. P2 enp1 greatly narrowed proximally, with pair of hooks arising distal to the contriction and directed towards the base of the leg (1).

FEMALE P5 uniramous, three to four-segmented, distal segment with three, or sometimes two, long setae (1).

MALE rt P5 distal segment slightly widened, third segment with long, curved process on inner margin (1).

The long Ur, rounded head, relatively short A1 and P2 enp1 hooks separate this genus from other local genera.

References:

1) Brodsky, 1950

20.1.1 Metridia curticauda Giesbrecht, 1889

Morphology:

Hd strongly tapered apically in profile; Ur elongate, approximately 0.6 x length Pro; PLC rounded; A1 longer than Pro, but do not reach past ansgt; P5 uniramous; P2 enp1 with hooks (1, 2).

FEMALE TL 2.5-3.6 mm; P5 three-segmented; apical segment reduced, bearing three subequal setae (1, 2).

MALE TL 2.0-3.1 mm; P5 four-segmented; lft 2P5 with strongly curved process directed inward (1, 2).

Separable from other local members of the genus by size, the moderate length of the A1, and in the female the approximately subequal apical setae on the P5.

Distribution and Occurrence:

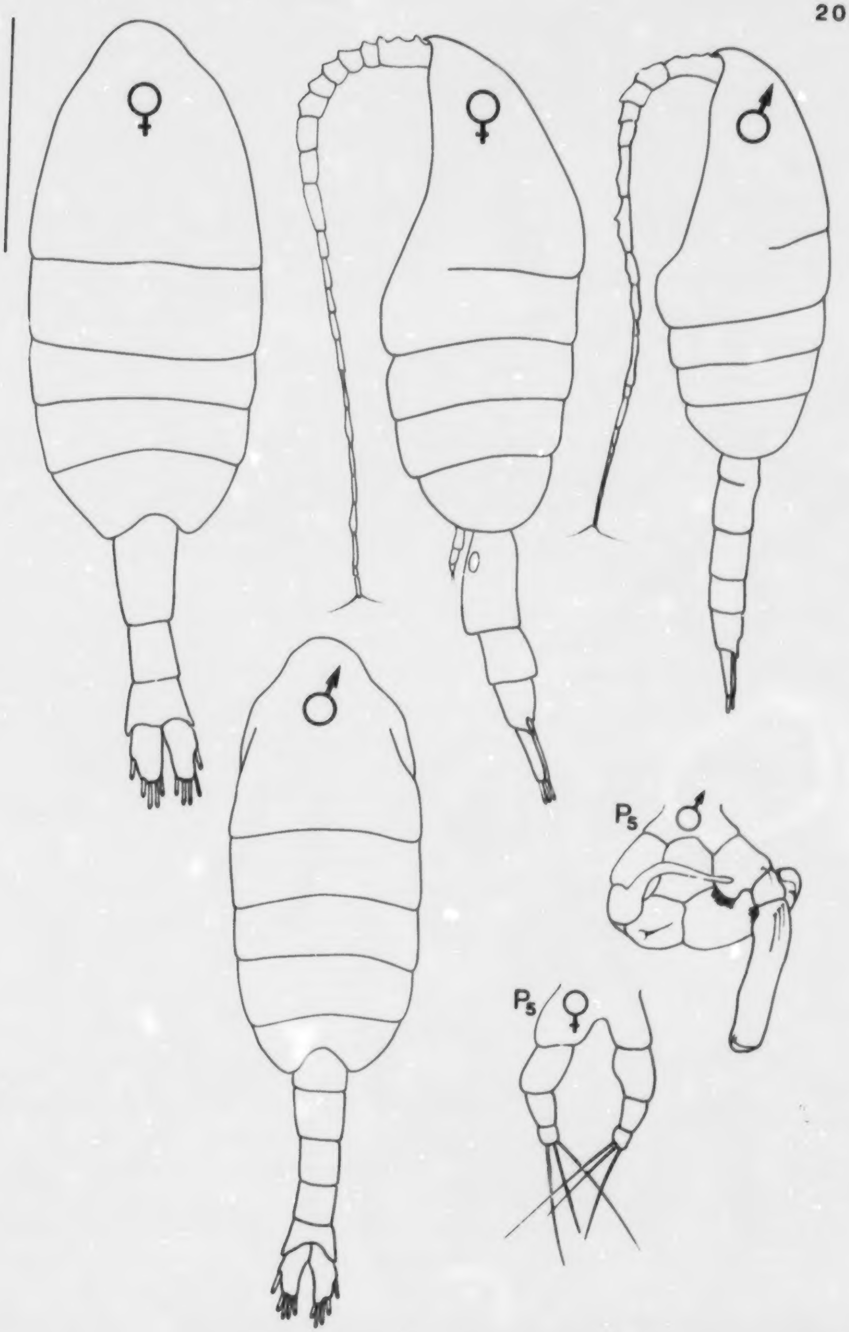
Atlantic Ocean, Bay of Bengal, Antarctic waters; Pacific Ocean from 35°N latitude to 3°S latitude; northwestern Pacific Ocean, Bering Sea, Malay Archipelago (1, 2). Locally, recorded from the Strait of Juan de Fuca (3).

Life History:

Juveniles undescribed, however the female CV should be distinguishable based on the length of the A1 and the apical setae on the P5.

References:

1) Brodsky, 1950
2) Tanaka, 1963
3) Chester et al., 1980



Metridia curticauda

from Brodsky,1950; Tanaka,1963

20.1.2 Metridia lucens s.l. Boeck, 1864

Synonymy:

Metridia hibernica: Giesbrecht (1892)

Morphology:

Ur elongate; Pro:Ur ratio about 1.8; Hd profile flattened anteriorly; A1 short; Pro widest in anterior third of its length; P2 enp1 with hooks (1).

FEMALE TL 2.5-2.9 mm; P5 widely variable, but with three terminal setae usually varying in length, innermost longest (1).

MALE TL 2.0-2.3 mm; P5 uniramous, rt 2P5 with curved, elongate inner process (1).

Separable from almost all other local members of the genus by its relatively small size and short A1; however, can only be separated from M. lucens s.l. on the basis of complicated body measurements (2). M. lucens adult females from Indian Arm, British Columbia, have a shorter Pro (1.79 mm vs 2.08 mm for M. pacifica), and adult males have a wider ansgt (0.14 mm vs 0.12 mm for M. pacifica). The ranges of these measurements overlap, but their 95% confidence intervals do not.

Distribution and Occurrence:

The Atlantic form has been reported from the Barents, Norwegian and North Seas, North and temperate Atlantic, English Channel and Mediterranean Sea (1). The distribution of the Pacific form cannot be readily separated from the distribution of M. pacifica; however, M. lucens s.l. appears to be the the form found in Indian Arm (2).

Life History:

Juveniles undescribed; however, the elongate Ur and short A1 should allow identification of the CV and CIV and its separation from all similar species except for M. pacifica.

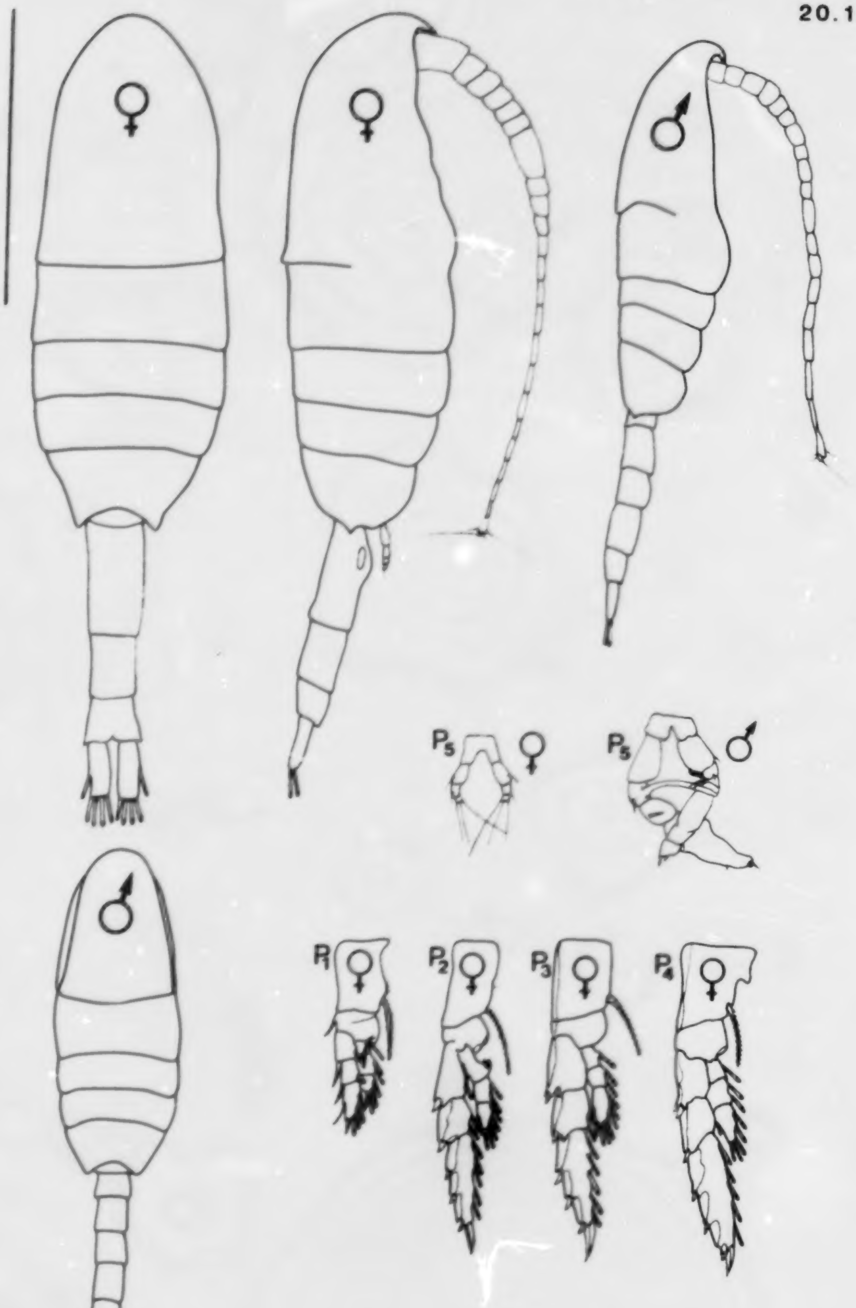
Comments:

M. lucens s.l. and M. pacifica cannot be readily separated although they appear to be statistically distinct on the basis of body segment measurements (2). The Metridia species found in Indian Arm conforms to the general description of M. lucens from the Atlantic; however, comparison of specimens from both locations indicates statistical differences in various body measurements (2). Here, we consider the Indian Arm form to be M. lucens s.l. The latter species should be further studied and assigned an appropriate name. Further studies are also required to allow better separation of M. lucens s.l. from M. pacifica, so that the distributions of these two species can be clearly defined.

References:

1) Brodsky, 1950 2) Thorp, 1980

20.1.2


♀
♀
♂
P5 ♀
P5 ♂
♂
P1 ♀
P2 ♀
P3 ♀
P4 ♀

Metridia lucens

from Thorp, 1972

20.1.3 Metridia okhotensis Brodsky, 1950

Synonomy:

Metrida longa: Campbell (1929b); Davis (1949b); Cameron (1957)

Morphology:

FEMALE TL 4.5-4.8 mm; A1 shorter than Pro; PLC rounded; Pro:Ur ratio approximately 1.7. P5 with elongate inner lateral seta and two subequal terminal setae (1, 2).

MALE Undescribed.

Separable from other members of the genus by size, the configuration of setae on the P5, the length of the A1 and the relative length of the Ur.

Distribution and Occurrence:

Reported from the Sea of Okhotsk and northeastern Pacific (3). Deep and common in the Strait of Georgia (4, 5); reported also from the vicinity of the Queen Charlotte Islands (6).

Life History:

Juveniles undescribed, key valid for adults only.

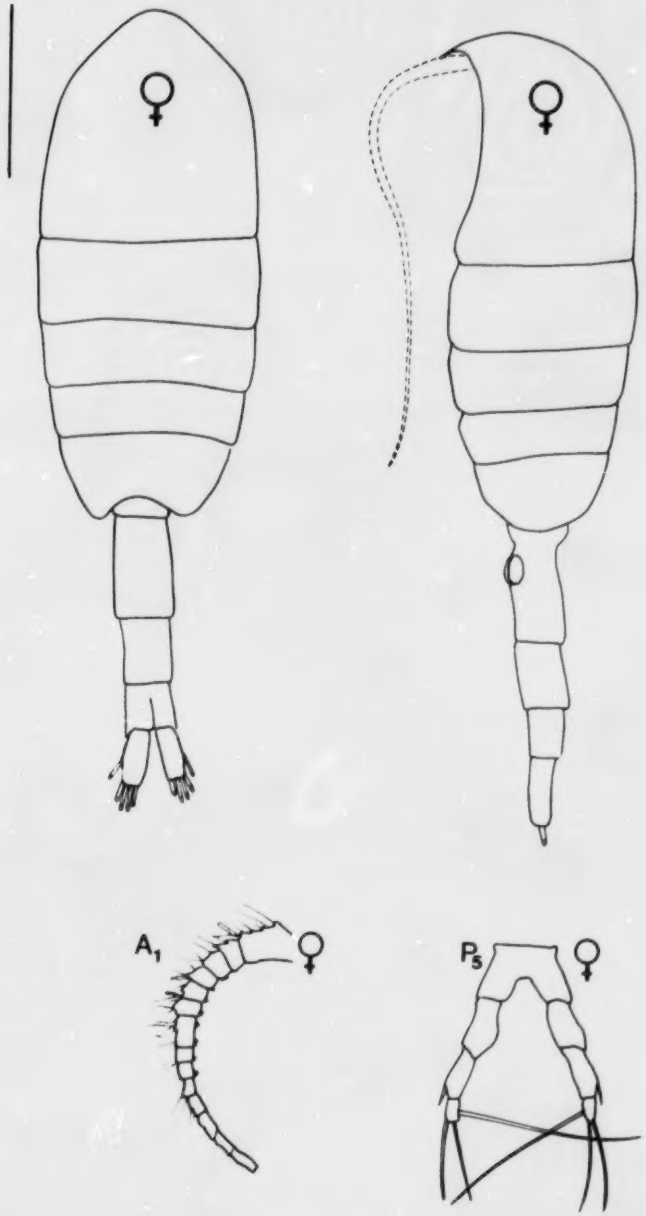
Comments:

One of the larger copepods in the study area, occasionally abundant and may be an important food source to planktivores.

References:

1) Brodsky, 1950
2) Tanaka, 1963
3) Davis, 1949b
4) Campbell, 1929b
5) Fulton, 1972
6) Cameron, 1957

20.1.3



Metridia okhotensis

from Brodsky,1950; Tanaka,1963

20.1.4 *Metridia pacifica* Brodsky, 1950

Synonymy:

Metridia lucens: Campbell (1929b); Davis (1949b); Cameron (1957); Legare (1957)

Morphology:

Ur elongate; Pro:Ur ratio about 1.8; Hd profile flattened anteriorly; A1 short; Pro widest in anterior third of its length (1).

FEMALE TL 2.6-3.1 mm; P5 widely variable, but usually with three subequal terminal setae (1).

MALE TL 2.0-2.1 mm; P5 uniramous, rt 2P5 with curved, elongate inner process (1).

Separable from almost all other members of the genus by its relatively small size and short A1; however, can only be separated reliably from *M. lucens* s.l. on the basis of complicated body measurements (2). *M. pacifica* adult females have a longer Pro (2.08 mm vs 1.79 mm for *M. lucens* s.l.) and adult males of *M. pacifica* have a narrower ansgt (0.12 mm vs 0.14 mm for *M. lucens* s.l.). There is some overlap in the ranges of these measurements, but not in their 95% confidence limits.

Distribution and Occurrence:

Reported from the North Pacific, Sea of Japan, Bering Sea, southern Chukchi and Okhotsk Seas (1). Locally, abundant and reported throughout the study area (3, 4, 5). The presence of the very similar *M. lucens* s.l. in the study area and perhaps elsewhere in the North Pacific suggests that some records of *M. pacifica* may refer to either or both species (2).

Life History:

Undescribed; however, the elongate Ur and short A1 should allow identification of the CV and CIV and its separation from all similar species except for *M. lucens*. Lengths have been reported for the copepodite stages (5).

Total Length (mm):

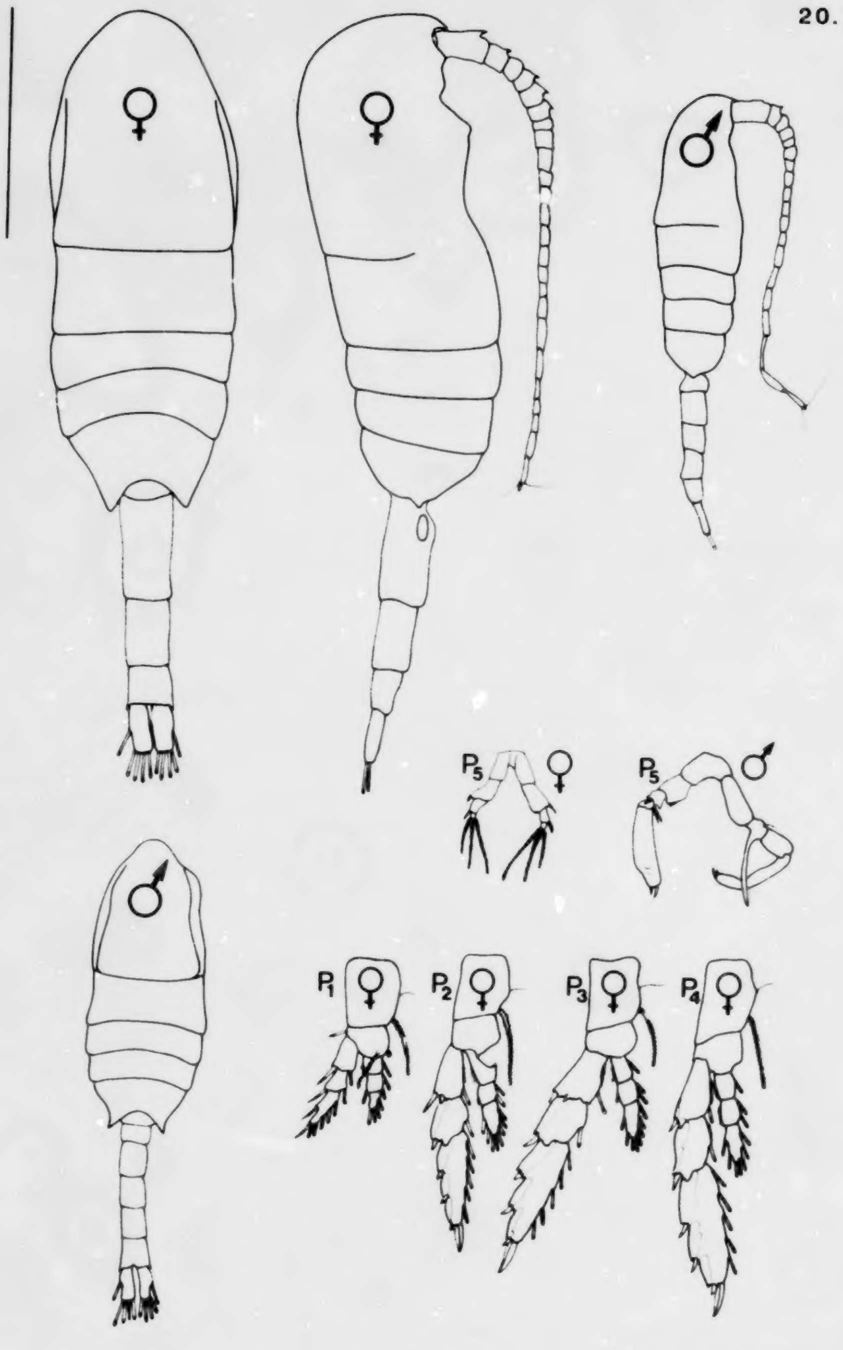
fCV	1.8-2.1	CIV	1.28	CII	0.74
mCV	1.5-1.8	CIII	1.08	CI	0.53

Comments:

See discussion *M. lucens*.

References:

1) Brodsky, 1950
2) Thorp, 1980
3) Campbell, 1929b
4) Cameron, 1957
5) Fulton, 1972


♀
♀
♂
P5 ♀
P5 ♂
♂
P1 ♀
P2 ♀
P3 ♀
P4 ♀

Metridia pacifica

from Thorp, 1972

20.1.5 Metridia princeps Giesbrecht, 1889

Morphology:

Ur elongate; Pro:Ur ratio 1.3; Ro a bifurcate plate bearing two moderately long hairy filaments; PLC rounded; A1 at least as long as TL (1, 2).

FEMALE TL 7.1-8.5 mm; P5 uniramous, with four segments (including the base of the leg), 2P5 bearing bundle of long setae at outer distal corner. 3P5 with three subequal apical setae (1, 2).

MALE TL 6.8-8.2 mm; A1 geniculate; ansgt wide with projecting corners; CR twice length of ansgt and much longer than wide. Rt P5 uniramous, four-segmented, rt 2P5 bearing long, slender inner process, rt 3P5 bearing a parallel plate separate from the segment; lft P5 uniramous, shorter than right, lft 2P5 and 3P5 fused (1, 2).

Readily identified by the size, the elongate Ur and the long A1.

Distribution and Occurrence:

A widely distributed, deep-water species occurring in all great oceans including the Arctic and Antarctic regions (2). Locally, reported from Queen Charlotte Strait (3).

Life History:

TL are reported for the CV male (5.7 mm) and female (5.8-6.3 mm) (2). CV should be separable based on size, elongate Ur and relatively long A1.

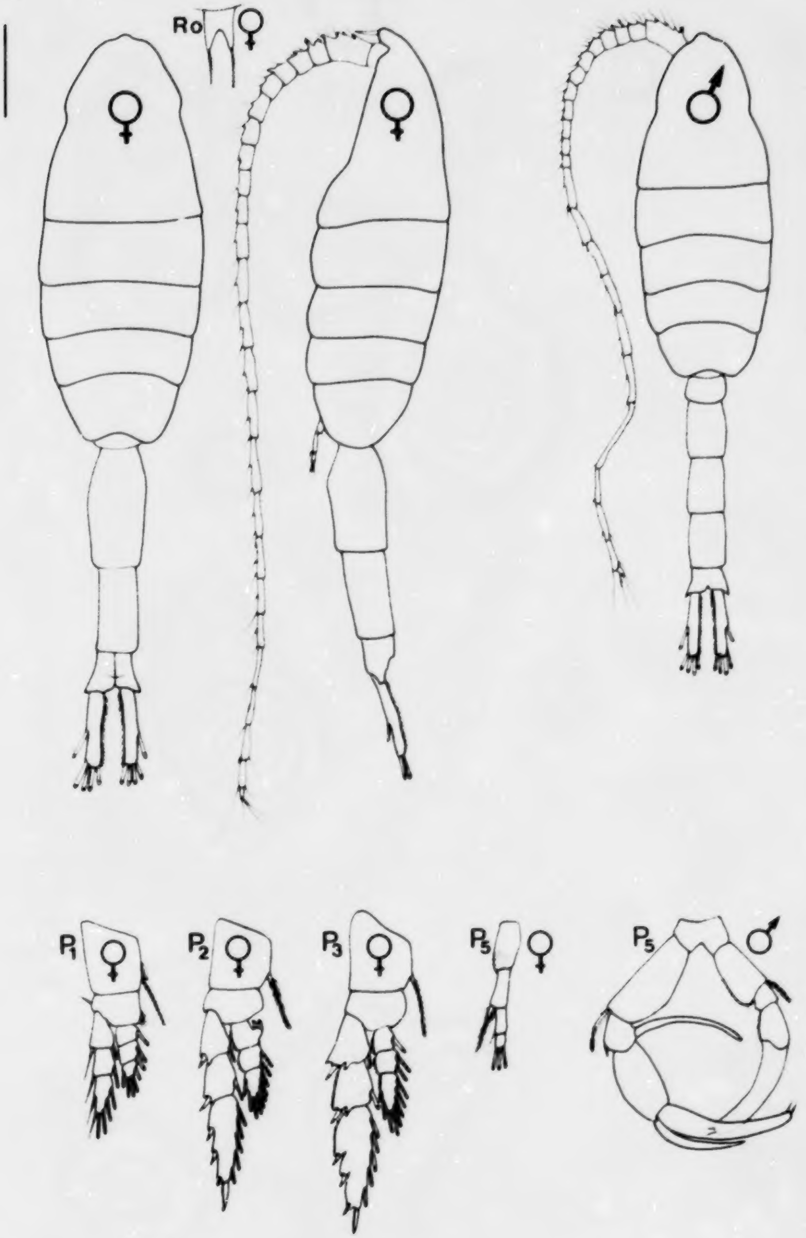
Comments:

A deep-water species which, if found in shallow continental shelf areas, may indicate intruding deep oceanic water.

References:

1) Brodsky, 1950
2) Vervoort, 1965
3) Stone, 1980

20.1.5



Ro ♀
♀
♀
♂
P1 ♀
P2 ♀
P3 ♀
P5 ♀
P5 ♂

Metridia princeps

from Sars, 1925

20.2 Pleuromamma Giesbrecht, 1898

Morphology:

Black pigment spot located on either rt or lft side of Thl; Al often armed proximally with large outer denticles, Ur shorter than in Metridia and often asymmetrical; Hd with short, acute apical process; Ro prominents and massive, with two hairy filaments. P2 enpl asymmetrical and either one (or more commonly) both uncinate; P3 expl outer distal spine with elongate base demarcated by deep notch (l, 2, 3).

FEMALE Ur three-segmented; P5 uniramous, two- to four-segmented, fourth segment usually small; distal segment with several long setae or spines; inner margin of two segments usually setose (l, 2, 3).

MALE P5 uniramous, asymmetrical; rt P5 distal segment strongly curved, preceding segment with long, curved inner process (l, 2, 3).

The pigment spot, Hd process and Ro shape separates this genus from all others. Large outer denticles located on the proximal portion of Al are also found in Gaussia.

	Pleuromamma	Scaphocalanus	Chirundina
Pl expl with spine	y	n	y
Al with proximal denticles	+	n	n
P2-P4 with surface spination	n	y	n

References:

1) Brodsky, 1950
2) Farran, 1948g (Fiches, Sheet 17)
3) Mori, 1937

20.2.1 Pleuromamma abdominalis (Lubbock, 1856)

Synonymy:

Pleuromma abdominale: Claus (1863)

Morphology:

Pigment spot usually on the lft side; head apex angular, but without process in dorsal view; AI denticulate (1).

FEMALE TL 2.4-4.4 mm; AI with two large denticles proximally; Ur symmetrical. P5 four-segmented, distal segment bearing three unequal apical setae and two thin spines, inner margins of 3P5, 4P5 setose (1).

MALE TL 2.7-4.3 mm; rt AI geniculate, proximal segments denticulate. Ur extremely asymmetrical, with long, thick bundles of setae. Lft P5 distal segment very broad (1).

This species is very similar to the large P. xiphias. Both female and male can be differentiated by the lack of an acute apical process on the Hd. In the female, the denticle on the second proximal segment is smaller and directed forward, and in the male the asymmetrical projections on the Ur are more pronounced than in P. xiphias.

Distribution and Occurrence:

Surface dwelling in the tropical Atlantic, Pacific and Indian Oceans, with one variety found near the coast of California and in the southern Sea of Okhotsk (1). Locally, reported from Queen Charlotte Strait (2).

Life History:

Juveniles undescribed, key valid for adults only.

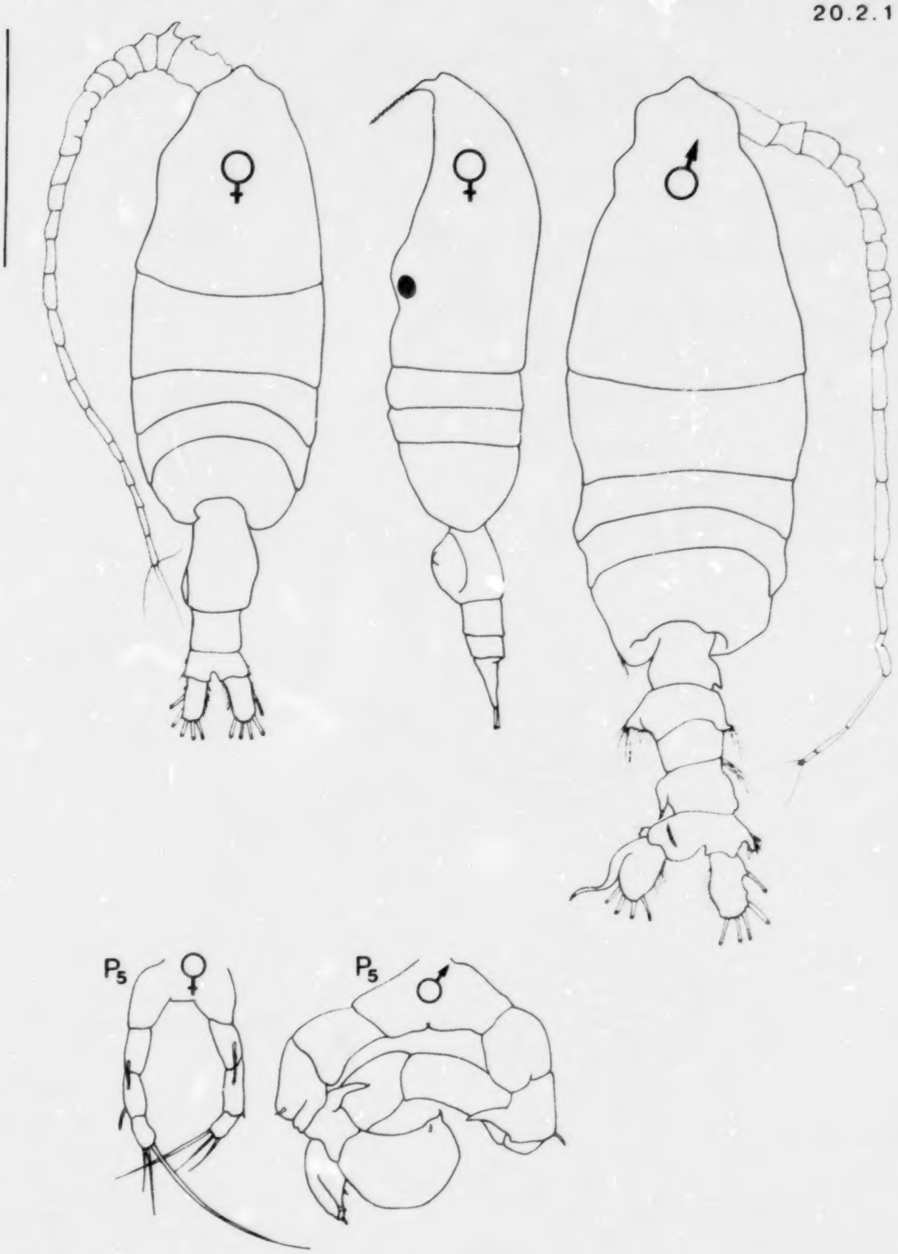
Comments:

Some authors subdivide this species into three varieties (3); however, here we consider the species in its broadest sense.

References:

1) Brodsky, 1950
2) Stone, 1980
3) Vervoort, 1965

20.2.1



Pleuromamma abdominalis

from Mori,1937;Owre and Foyo,1967

20.2.2 Pleuromamma borealis (Dahl, 1893)

Synonymy:

Pleuromamma gracilis: Esterly (1905, 1912)
NOT P. gracilis: Brodsky (1950, 1962)

Morphology:

Pigment spot on rt side; P5 uniramous (1).

FEMALE TL 1.67-2.46 mm; P5 with three segments, three unequal apical spines, the outer being longest, inner margins not setose (1).

MALE TL 1.47-2.13 mm; rt P2 enpl uncinate, lft 3P5 with a short, blunt projection (1).

Separable from the other local species in the genus by the small size, the lack of denticles on the A1, and in the female the presence of three segments in the P5.

Distribution and Occurrence:

Widely distributed over tropical, subtropical and temperate parts of the Atlantic and Indian Oceans (e.g. between 60°N and 55°S in the Atlantic), more southerly in the Pacific, but reported from the coast of California and the central tropical Pacific (2). Locally, reported from Queen Charlotte Strait (3).

Life History:

Juveniles undescribed; however the small size should allow differentiation of the CIV and CV.

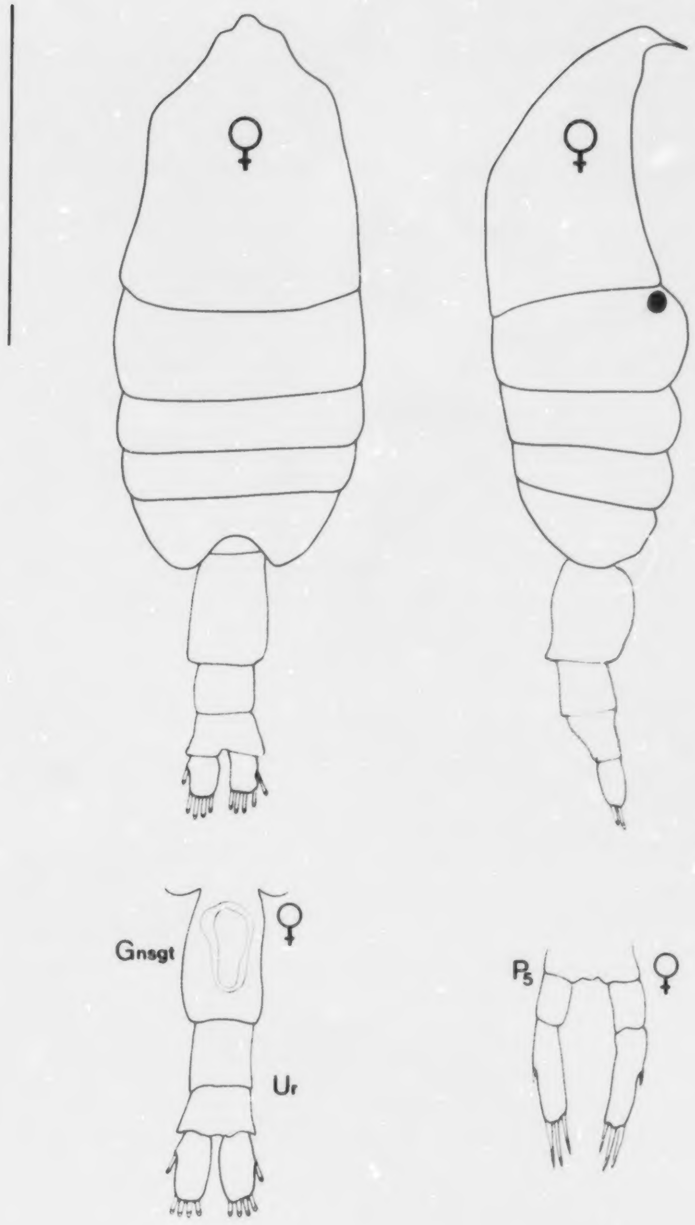
Comments:

Except for the structure of the adult P5, P. borealis is very similar to P. gracilis, which has not been reported from the study area, but elsewhere has a similar distribution (2).

References:

1) Brodsky, 1950
2) Vervoort, 1965
3) Stone, 1980

20.2.2



Pleuromamma borealis

from Rose,1933; Grice,1961

20.2.3 Pleuromamma quadrungulata (Dahl, 1893)

Morphology:

Pigment spot on rt side (1).

FEMALE TL 3.3-5.0 mm; A1 bearing long, incurvate denticles on proximal segments as follows: 1A1 with two denticles, 2A1 and 4A1 each with one denticle. P5 uniramous with four segments, 4P5 with three unequal apical setae, inner setae longest (1).

MALE TL 3.1-4.5 mm; A1 geniculate, also with denticles; Ur symmetrical; P2 enpl uncinate on both sides (1).

Female separable from other members of the genus on the basis of the number of denticles on the A1 (4), and the orientation of these denticles (all are directed medially). Male separable based on the symmetry of the Ur.

Distribution and Occurrence:

Widely distributed in waters of intermediate and great depths in the tropical and subtropical Atlantic, Indian and Pacific Oceans (2). Locally, deep and rare in the Strait of Georgia (3), Queen Chrlotte Strait (4) and the Strait of Juan de Fuca (5).

Life History:

Juveniles undescribed; however, the character of the AI denticles should allow the identification of the CV.

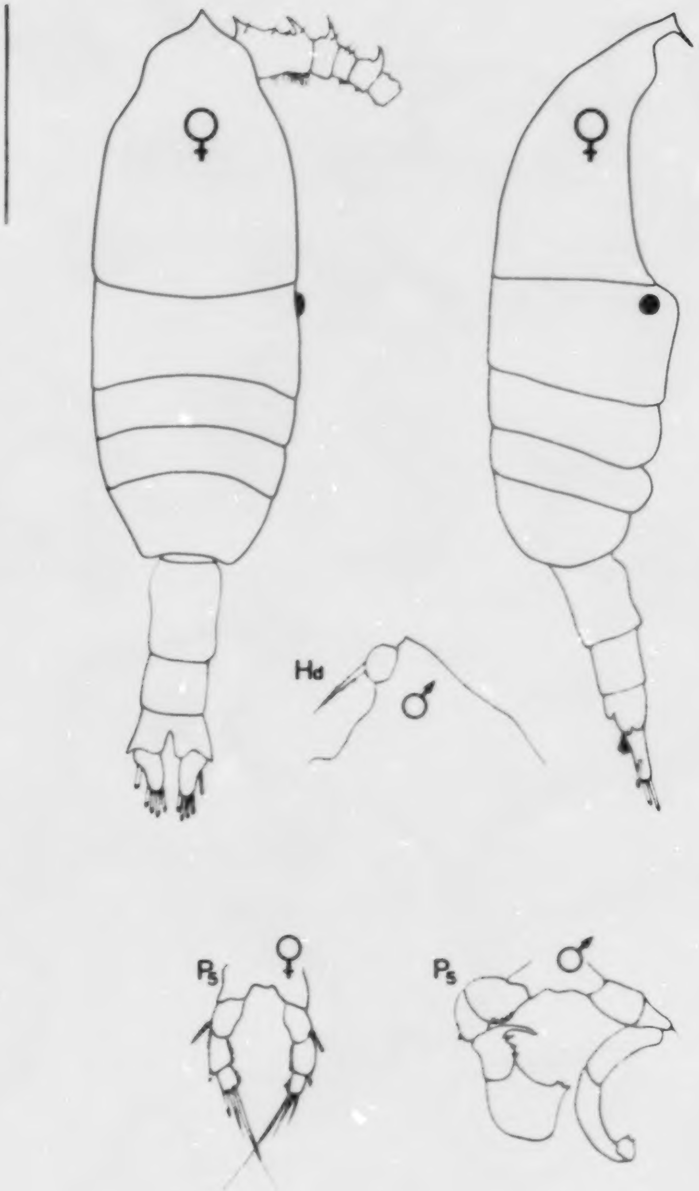
Comments:

This species is sometimes considered to have two varieties (2), but here we consider the species in its broadest sense. In newly caught specimens, minute red spots may be visible on the ventral surface and leg basipodites (1).

References:

1) Brodsky, 1950
2) Vervoort, 1965
3) Fulton, 1972
4) Stone, 1980
5) Chester et al., 1980

20.2.3



Pleuromamma quadrungulata

from Brodsky,1950; Grice,1961; Owre and Foyo,1967

20.2.4 Pleuromamma robusta (Dahl, 1893)

Morphology:

AI without denticles (1, 2).

FEMALE TL 2.7-4.5 mm; P5 uniramous, four segments, terminal segment with three apical spines, the inner being longest (1, 2).

MALE TL 3.0-3.4 mm; Ur symmetrical (1, 2).

Separable from other local members of the genus by size, the lack of denticles on the AI and in the male the symmetry of the Ur.

Distribution and Occurrence:

Reported from the North Atlantic and Indian Oceans (1). Locally, reported from the Strait of Juan de Fuca (3).

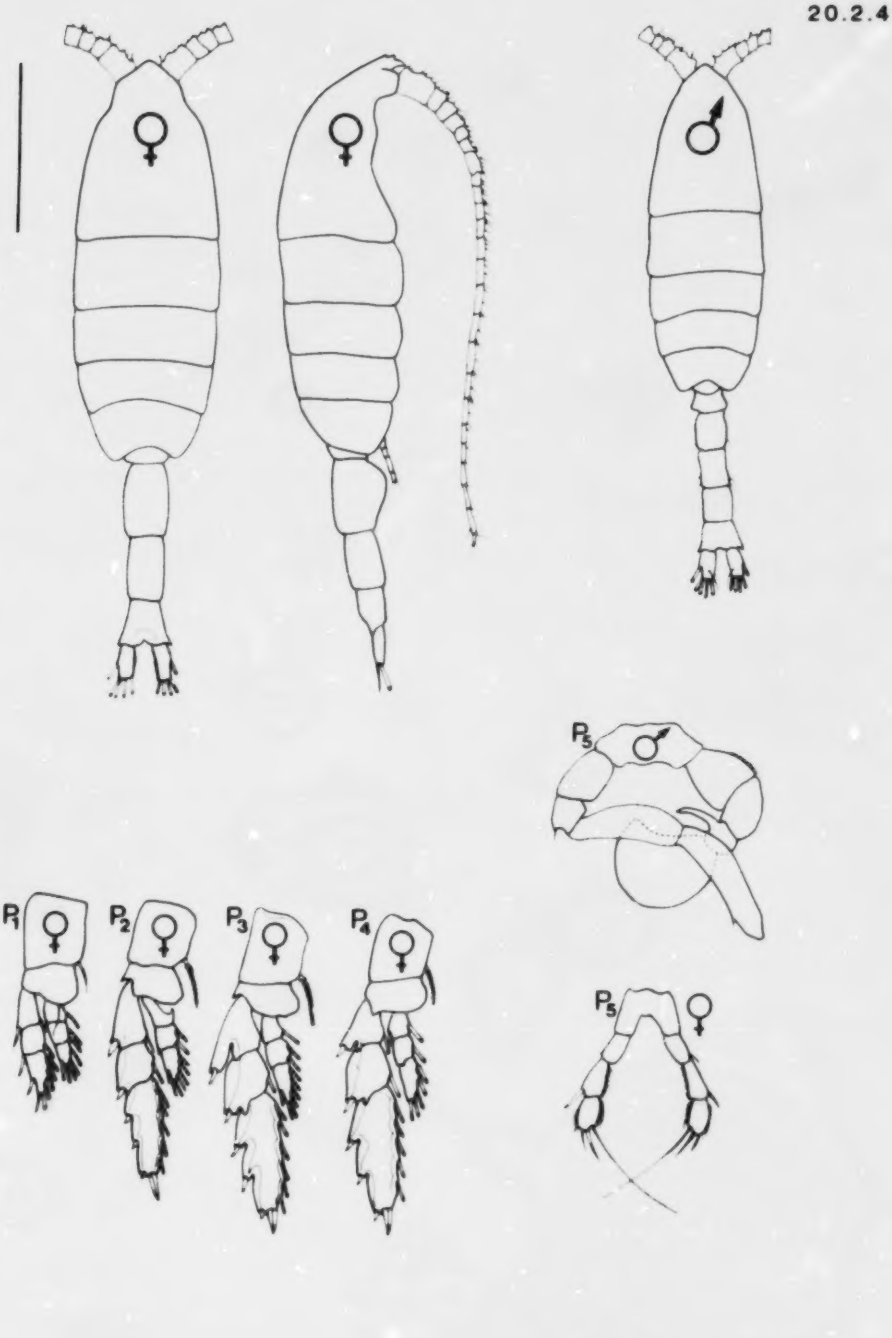
Life History:

Juveniles undescribed; however the lack of AI denticles and the size should allow separation of the CV.

References:

1) Farran, 1948g (Fiches, Sheet 17)
2) Mori, 1937
3) Chester et al., 1980

20.2.4


♀
♀
♂
P5 ♂
P1 ♀
P2 ♀
P3 ♀
P4 ♀
P5 ♀

Pleuromamma robusta

from Sars,1903

20.2.5 Pleuromama scutullata Brodsky, 1950

Morphology:

Pigment spot on rt side; Pro:Ur ratio approximately 0.44; A1 reach midpoint of Ur; proximal segments of A1 denticulate (1).

FEMALE TL 3.6-4.0 mm; Pro with border between Hd and Th1 marked laterally by a ridge visible in dorsal view. P5 with four segments, distal segment with three long apical setae, inner seta as long as the leg (1).

MALE TL 3.1-3.2 mm; Ur symmetrical; lft A1 geniculate; rt P5 distal joint strongly widened; preceding joints with acute inner process, almost chela-like in appearance, but not articulating (1).

Separable from other local members of the genus by the number of denticles on the A1 (more than two), the tendency for the denticles to be oriented in different directions, and the symmetry of the mUr.

Distribution and Occurrence:

A deep-water species reported from the northwestern Pacific, Bering Sea and southern Sea of Okhotsk (1). Locally, reported from Queen Charlotte Strait (2).

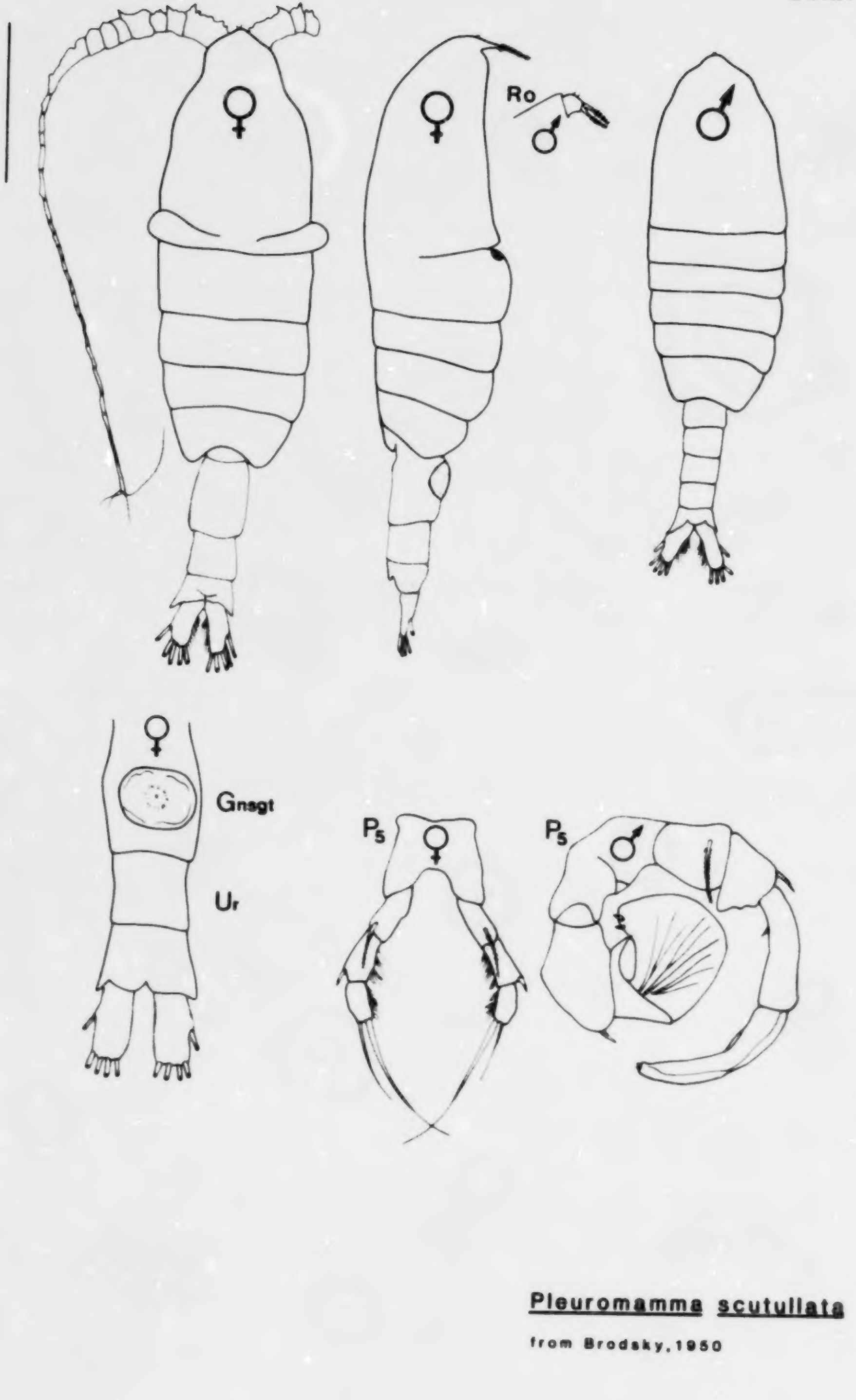
Life History:

Juveniles undescribed; however, the number and orientation of the denticles should allow identification of the CV.

References:

1) Brodsky, 1950
2) Stone, 1980

20.2.5


♀
♀
Ro
♂
♂
♀
Gnsgt
Ur
P5
♀
P5
♂

Pleuromamma scutullata

from Brodsky, 1950

20.2.6 Pleuromamma xiphias (Giesbrecht, 1889)

Morphology:

Hd apex with an acute process which arises near the base of the Ro and is bent slightly downward, visible in dorsal and lateral views (1).

FEMALE TL 3.5-5.9 mm; Ur symmetrical; P5 four-segmented, distal segment bearing three apical setae, inner margins of 3P5, 4P5 setose (1).

MALE TL 4.0-6.4 mm; rt A1 geniculate; proximal segments denticulate, Ur asymmetrical, with long, thick bundles of setae (1).

This species is very similar to the smaller P. abdominalis. Both female and male can be identified by the acute apical process on the Hd. In the female the large denticle on the second proximal segment of the A1 is directed medially, and in the male the asymmetrical projections on the Ur are more pronounced in P. abdominalis.

Distribution and Occurrence:

Found generally between 200 and 1000 m in tropical and subtropical zones of the Atlantic, Indian and Pacific Oceans, reaching northward along the eastern margin of the North Pacific (1). Locally, reported from Queen Charlotte Strait (2).

Life History:

Juveniles undescribed; however, the Hd process should allow separation of the CIV and CV.

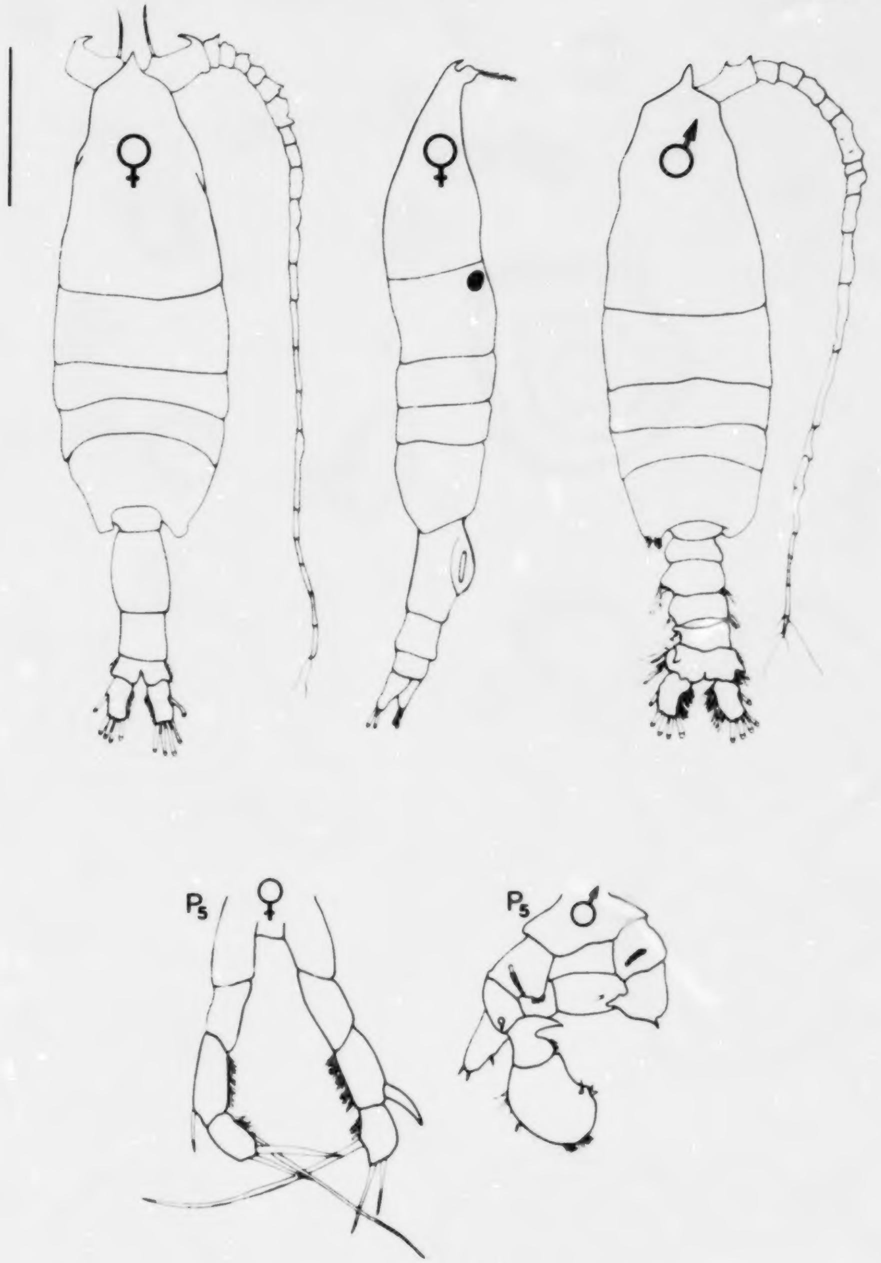
Comments:

Rare in the study site, and may indicate intrusions of equatorial water (3).

References:

1) Brodsky, 1950
2) Stone, 1980
3) Gardner, 1982a

20.2.6



Pleuromamma xiphias

from Esterly, 1905; Mori, 1937

20.3 Gaussia Wolfenden, 1905

Morphology:

Proximal portion of A1 with denticles; no pigment spot on Th1; PLC produced into long spikes; ansgt with wing-like processes directed backward and partially concealing the short CR. P2 enp1 with two inner hooks (1).

FEMALE Ur three-segmented; gnsgt usually symmetrical and always greatly inflated. P5 uniramous, four or five segments, distal segments setose (1).

MALE Ur five-segmented; P5 uniramous, three-segmented, rt P5 without long, curved inner process (1).

Large outer denticles located on the proximal portion of A1 are also found in Pleuromamma. Gaussia can be separated from other local genera by the distinctive angst.

References:

1) Brodsky, 1950

20.3.1 Gaussia princeps (T. Scott, 1894)

Synonymy:

Metridia scotti: Giesbrecht (1897)
Gaussia scotti: Wolfenden (1905, 1908, 1911)
G. melanotica: Wofenden (1905)
Metridia atra: Esterly (1906, 1912)

Morphology:

Hd with short, rounded apical process; Ro with two long, hairy filaments; PLC elongated as spikes; ansgt with blunt, conical processes laterally which obscure the origin of the outer lateral setae of the CR; A1 at least as long as TL (1, 2).

FEMALE TL 9.0-12.0 mm; gnsgt inflated, asymmetrical (1, 2).

MALE TL 8.0-12.0 mm; PLC spikes shorter and blunter than female. A1 geniculate (1, 2).

The only species of the genus found in the study area. Identifiable by its size, the shape of the PLC, f gnsgt, the Ro and the other characters noted above and in the description of the genus.

Distribution and Occurrence:

A characteristic bathypelagic species which is widely distributed over large deep-water areas of the Atlantic, Indian and Pacific Oceans (2). Locally, recorded from Queen Charlotte Strait (3) and off Cape Flattery (4).

Life History:

Juveniles undescribed, but sizes have been reported for some juvenile stages (2).

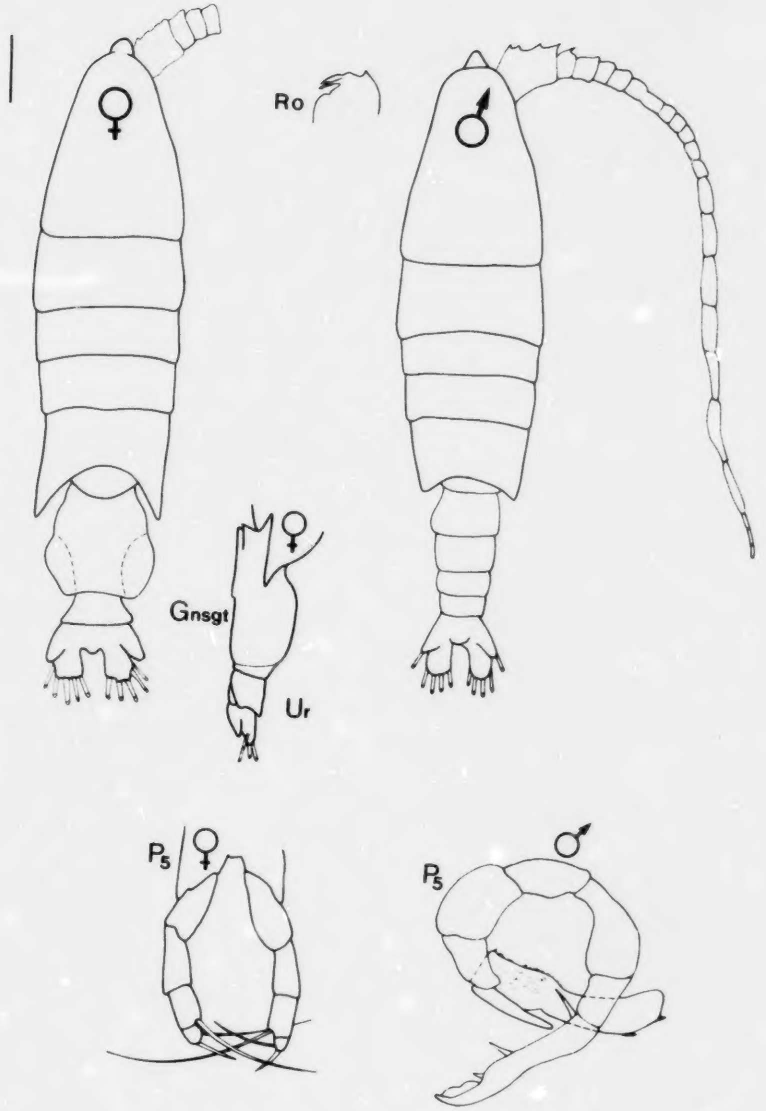
Total Length (mm):

fCV	7.8-9.0
mCV	6.7-8.3
fCIV	5.3-6.4
mCIV	5.4-7.6
CII	3.6-4.6

References:

1) Brodsky, 1950
2) Vervoort, 1965
3) Stone, 1980
4) Davis, 1949b

20.3.1


♀
Ro
♂
♀
Gnsgt
Ur
P5
♀
♂
P5

__Gaussia__ __princeps__

from Brodsky, 1950

21.1 Centropages Kroyer, 1848

Morphology:

Hd narrowed; PLC commonly terminating in acute or blunt projections, rarely rounded; CR elongate, often asymmetrical. P1,2 segmentation: 3-3/3-3 (1).

FEMALE Ur three-segmented; gnsgt asymmetrical, almost always with spines and bristles. P5 biramous, symmetrical; exp and enp three-segmented; P5 exp2 with large inner process (1).

MALE Ur four- or five-segmented, often asymmetrical; rt A1 geniculate. P5 biramous, asymmetrical; rt P5 exp terminating with large chela (1).

	Centropages	Tortanus
f gnsgt with spines	y	n
P5 (m and f)	biramous	uniramous
Ro	present	absent

References:

1) Brodsky, 1950

21.1.1 Centropages abdominalis Sato, 1913

Synonymy:

Centropages mcmurrichi: Willey (1920); Campbell (1929b); Davis (1949a); Brodsky (1950); Legare (1957)
C. hamatus: McMurrich (1916)

Morphology:

CR elongate, lft CR slightly longer than rt (1).

FEMALE TL 1.6-2.1 mm; PLC with asymmetrical sharp spines, rt corner larger and directed laterally. Ur three-segmented, gnsgt with abundant and asymmetrical curvature of spines, and with prominent distally directed ventral spine (1).

MALE TL 1.5 mm; PLC shorter than in female, directed backward; rt P5 chelate (1).

Distribution and Occurrence:

A neritic species reported from the Sea of Japan, Sea of Okhotsk, Bering Sea and southern Chukchi Sea (1). Locally, abundant in the surface waters of the Strait of Georgia (2) and also reported from the vicinity of the Queen Charlotte Islands (3).

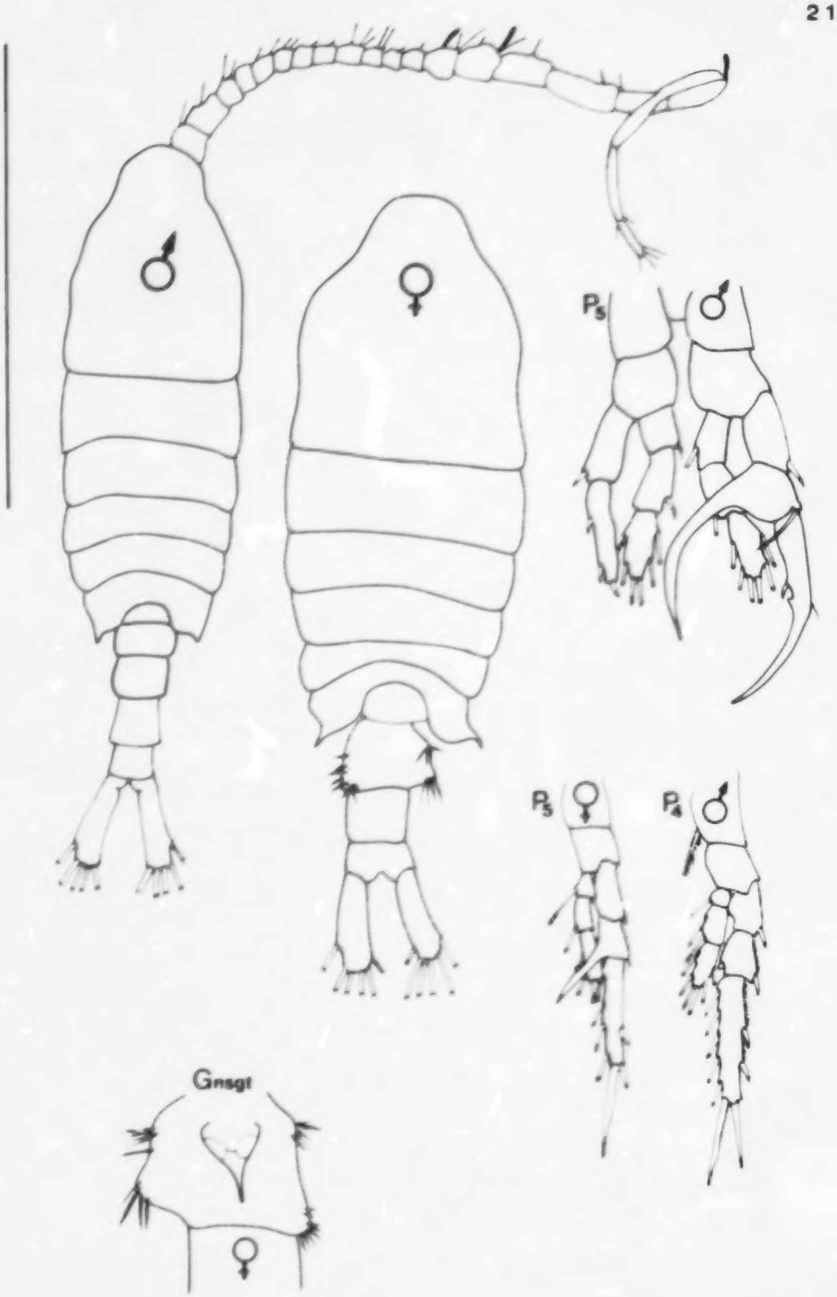
Life History:

Juveniles undescribed; however, the elongate, unequal CR and general body shape should allow identification of the CV.

References:

1) Brodsky, 1950
2) Fulton, 1972
3) Cameron, 1957

21.1.1


♂
♀
P5
♂
P5
♀
P4
♂
Gnsgt
♀

Centropages abdominalis

from Mori,1937

22.1 Lucicutia Giesbrecht, 1898

Morphology:

Ur, CR elongate; PLC rounded; Ro with two slender filaments. Segmentation of P1: 3-1 or 3-2; of P2: 3-3; P2 exp3 with five or six inner setae (1, 2).

FEMALE Ur four-segmented; P1 enp2 with tubular process near inner distal corner; P5 enp with three segments; exp 2 with styliform inner seta.

MALE Ur five-segmented; lft A1 geniculate. P5 asymmetrical, biramous; rt P5 exp usually two-segmented, enp reduced; lft P5 rami three-segmented.

References:

1) Brodsky, 1950
2) Hulsemann, 1966

22.1.1 Lucicutia bicornuta Wolfenden, 1905

Synonymy:

Lucicutia aurita: Sars (1905)

Morphology:

A very large copepod characterized by two large, terminally acute apical processes, one on each anterolateral corner of the cephalosome, and two similarly acute processes arising laterally in the Hd region and pointing posteriorly. CR thin and greatly elongate, equal in length to remainder of Ur; Pro:Ur ratio approximately 1.0; A1 longer than TL (1, 2).

FEMALE TL 6.8-8.4 mm; gnsgt with large ventral swelling distally (1, 2).

MALE TL 6.9-7.7 mm; lft A1 geniculate; lft P5 bp2 with two denticles on inner dorsal corner, rt P5 bp2 smooth (1).

The head shape and extremely long CR distinguish this species from all other local taxa.

Distribution and Occurrence:

Sub-tropical and tropical Atlantic Ocean, northwestern Pacific Ocean, Malay Archipelago, Sea of Japan and Indian Ocean in deep water (1, 2). Locally, reported from Queen Charlotte Strait (3).

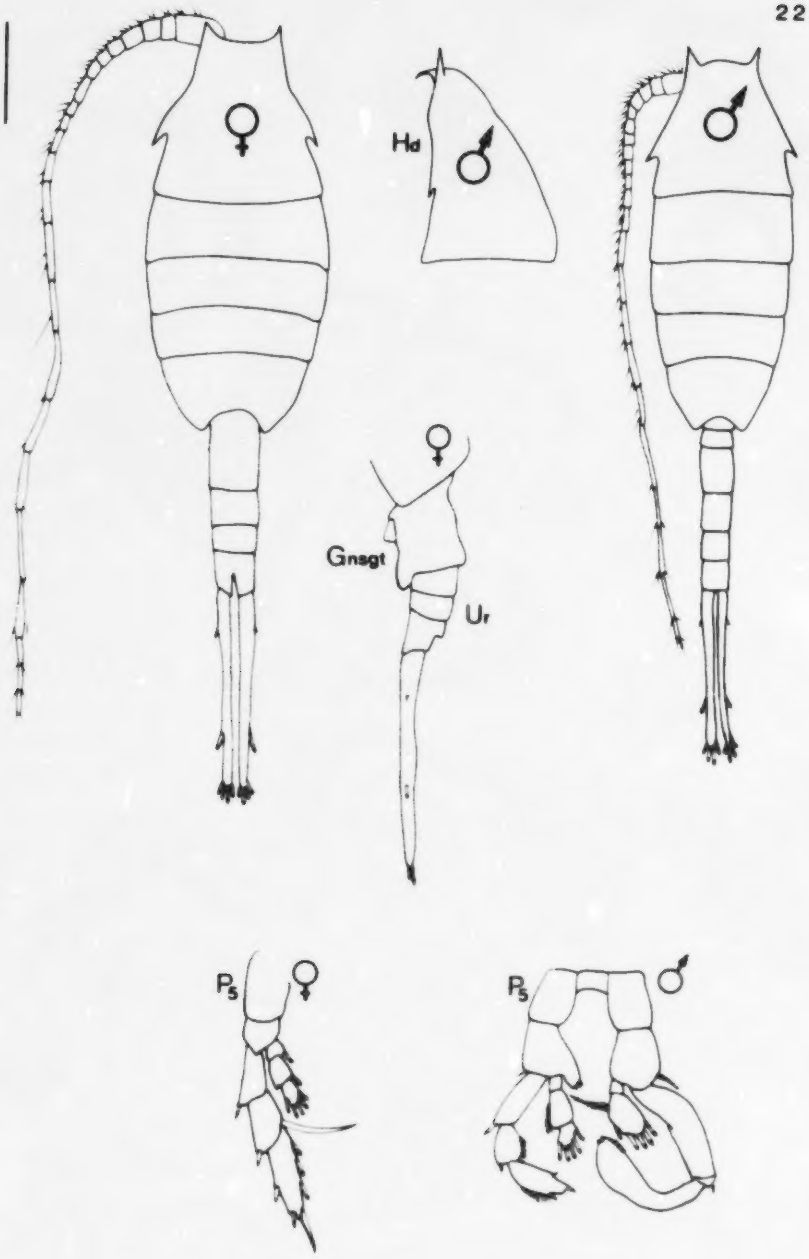
Life History:

Juveniles undescribed; however, the cephalosome projections and the elongate CR should allow identification in at least the CV. CV male TL 4.9-5.8 mm (4).

References:

1) Brodsky, 1950
2) Hulsemann, 1966
3) Stone, 1980
4) Vervoort, 1965

22.1.1


♀
Hd
♂
♂
♀
Gnsgt
Ur
P5
♀
P5
♂

Lucicutia bicornuta

from Sars, 1925, Brodsky, 1950; Tanaka, 1963

22.1.2 *Lucicutia flavicornis* (Claus, 1863)

Morphology:

Hd rounded, with apical papilla; Pro oval; Pro:Ur ratio approximately 1.5; CR elongate, as long as first two Ur segments combined; A1 reach mid point of CR. P2-P4 exp3 apical spines more than 1/2 length of the segment (1, 2, 3, 4).

FEMALE TL 1.3-2.2 mm; P5 enp three-segmented and reaches distal margin of P5 exp2, exp2 with short, recurved, inward directed spine at inner distal corner (1, 2, 3, 4).

MALE TL 1.3-1.7 mm; lft P5 bp2 with large inner protuberance bearing long denticles, rt P5 bp2 enlarged and setulose along inner margin, but without defined process (1, 2, 3, 4).

One seta per CR approximately equal to Pro length, when intact a very distinctive feature and unique among the local species.

Distribution and Occurrence:

Widely distributed in the Atlantic (73°N to 28°S), Pacific (58°N to 48°S) and Indian Oceans at various depths from near surface to as deep as 3000m (3, 4). Locally, rare, but recorded in samples held in the collection of the Institute of Ocean Sciences.

Life History:

Juveniles undescribed, will be difficult to separate from juveniles of *L. ovalis*; however, the relatively short Ur of *L. ovalis* may allow the separation of the CV's.

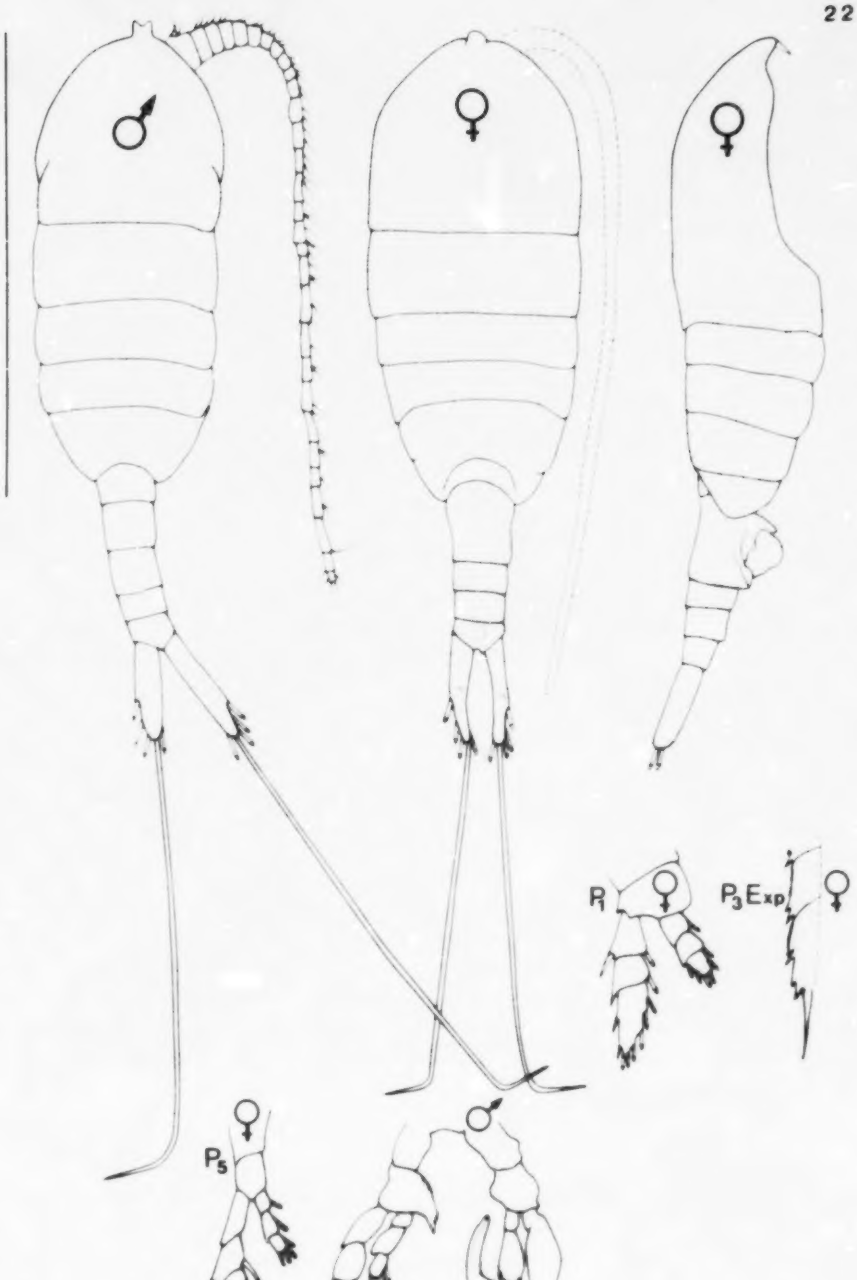
Comments:

Rare in the study area, and may indicate intrusions of equatorial water (5).

References:

1) Brodsky, 1950
2) Tanaka, 1963
3) Vervoort, 1965
4) Hulsemann, 1966
5) Gardner, 1982a

22.1.2



Lucicutia flavicornis

from Esterly, 1905; Brodsky, 1950; 1962

22.1.3 Lucicutia ovalis (Giesbrecht, 1889)

Synonymy:

Lucicutia frigida: Wolfenden (1911)
L. ovaliformis: Brodsky (1950)
NOT L. ovalis: Wolfenden (1906) (=L. gaussae Grice, 1963)

Morphology:

Hd round, without papilla; cephalothorax ovoid; Ro with two slender filaments; AI reaches ansgt. A2 rami subequal; P1,2 segmentation: 3-3/3-3 (1, 2, 3).

FEMALE TL 1.5-1.8 mm; gnsgt and CR each elongate and equal to approximately 1/3 the length of the Ur; gnsgt produced triangularly from distal ventral midline. P5 uniramous, enp two-segmented, approximately as long as expl; P5 exp three-segmented, long, exp2 with long spine arising from inner distal corner (1, 2, 3).

MALE TL 1.2-1.6 mm; lft A1 geniculate. P5 biramous, without denticles, bp2 with process on inner margin; rt P5enp three-segmented, exp two-segmented with second segment dilated distally (1, 2, 3, 4).

This species may be distinguished by the short Ur, the small, naked inner projection from each mP5 bp2, and in the female the two-segmented P5 enp.

Distribution and Occurrence:

Reported from the Atlantic, Pacific and Indian Oceans (3). Locally, reported from the Strait of Juan de Fuca (4).

Life History:

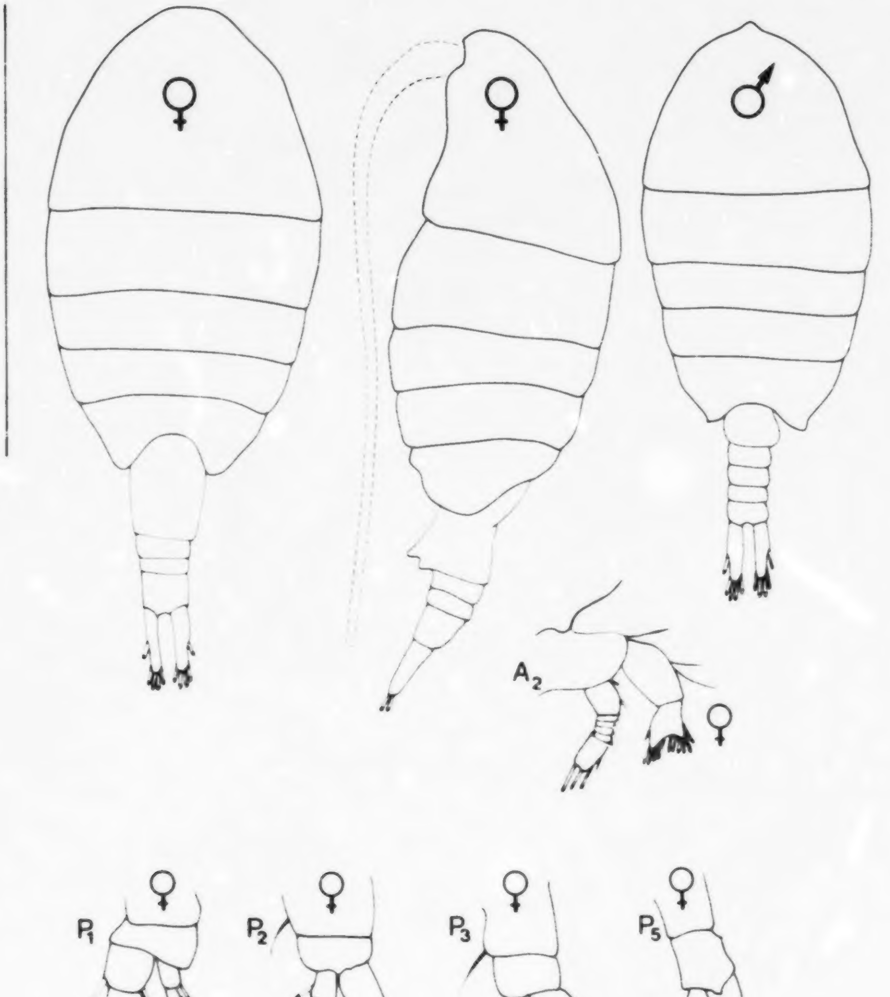
Juveniles undescribed; however, the relatively short Ur may allow identification of the CV.

Comments:

Grice (5) synonymized the genus Isochaeta with Lucicutia, which made Lucicutia ovalis Wolfenden a junior homynym of L. ovalis (Giesbrecht) (= Isochaeta ovalis). Wolfenden's species was renamed L. gaussae.

References:

1) Brodsky, 1950
2) Tanaka, 1963
3) Hulsemann, 1966
4) Chester et al., 1980
5) Grice, 1963


♀
♀
♂
A2
♀
♀
P1
♀
P2
♀
P3
♀
P5

Lucicutia ovalis

from Mori, 1937; Brodsky, 1950

23.1 Heterorhabdus Giesbrecht, 1898

Morphology:

Hd blunt, with clearly visible dorsal papilla; A1 usually short; A2 rami subequal; masticatory edge of mandible bearing a large, lateral tooth set off from the other teeth by a wide gap; max2 well developed distally, with two large, thick setae; mxp bp2 with a naked seta which may be much larger than the other setae on the segment. P5 biramous, symmetrical; exp and enp both three-segmented; P5 exp2 with long spine (1, 2).

FEMALE Ur three-segmented; gnsgt usually symmetrical and always greatly inflated; gnsgt ventral process large and protruding. P5 biramous, symmetrical, exp/enp: 3-3. P5 exp 2 with long spine (1, 2).

MALE Ur five-segmented; P5 biramous, asymmetrical; P5 bp2 with inner process; P5 exp3 terminating in acute point (1, 2).

	Heterorhabdus	Heterostylites	Euchaeta
P1, P2 segmentation	3-3/3-3	3-3/3-3	2(3)-1/3-1
max2 distal setae	thick, stout	reduced	#
A1	usually less than TL	longer than TL	#
md masticatory edge lateral tooth	set off by gap	not separated	#

References:

1) Brodsky, 1950
2) Farran, 1948f (Fiches, Sheet 16)

23.1.1 Heterorhabdus clausi (Giesbrecht, 1889)

Synonymy:

Heterochaeta clausii: Giesbrecht (1892); Wolfenden (1902)

Morphology:

A smaller member of the genus; A1 longer than TL; max2 armed with long apical setae (1, 2).

FEMALE TL 2.4-2.7 mm; P5 rami with three segments, expl with short spine on inner distal corner, exp2 with very large, inward directed spine at inner distal corner; P5 enp3 reaches proximal margin of exp3 (1, 2).

MALE TL 2.2-2.5 mm; P5 biramous, rt P5 bp2 bearing a finger-like, setulose projection from the inner margin, exp2 with short, triangular inner process, exp3 elongate and styliform; lft P5 bp2 with short, rounded, apically setulose swelling on inner margin, exp3 styliform and stongly curved (1, 2).

Separable from H. papilliger, the only other small (TL less than 2.8 mm) member of the genus, in the female by the inner distal spine on P5 expl, and in the male by the defined, apically setulose process on the lft P5 bp2 and the finger-like process arising from the rt P5 bp2 (compared with a broadly based process for H. papilliger). H. clausi is also slightly larger in size.

Distribution and Occurrence:

Widespread, but populations usually in isolated patches or small numbers. Reported from the North and South Atlantic, Indo-Pacific, central Pacific, and eastern North Pacific Oceans (2). Locally, reported from Queen Charlotte Strait (3).

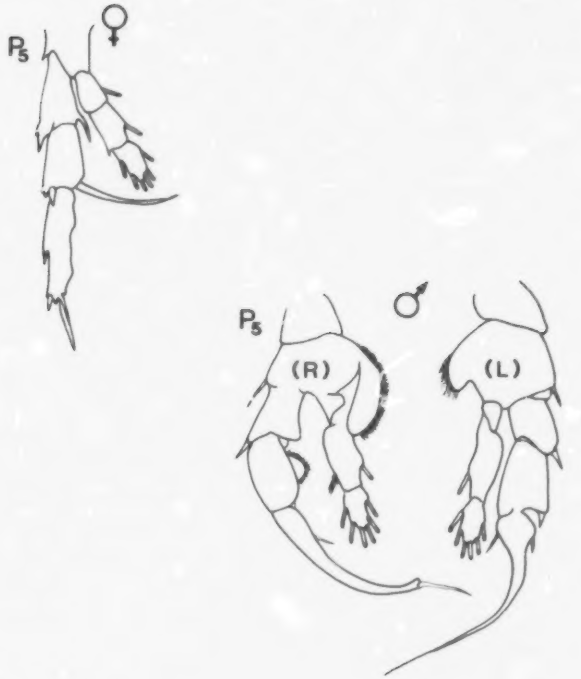
Life History:

Juveniles undescribed. Separable on the basis of size from most similar members of the genus, but cannot be reliably separated from H. papilliger except in the adult. The slight size difference between the two may persist in the CV, but there are no size data for H. clausi CV.

References:

1) Brodsky, 1950
2) Vervoort, 1965
3) Stone, 1980

23.1.1



Heterorhabdus clausi

from Giesbrecht, 1892

23.1.2 *Heterorhabdus papilliger* (Claus, 1863)

Synonymy:

Heterochaeta papilligera: Giesbrecht (1889); Dahl (1894)

Morphology:

A smaller member of the genus; A1 equal to TL (1, 2).

FEMALE TL 1.6-2.2 mm; gnsgt ventrally rounded and protruding greatly; P5 with three-segmented rami; enp3 reaches proximal margin of exp3, exp2 bearing large spine at inner distal corner (1, 2).

MALE TL 1.8-2.0 mm; rt P5 exp2 with very long inner process, bp2 with broadly based process on inner margin; lft P5 bp2 lacking any well-defined process from the inner margin, exp3 elongate, falciform (1, 2).

Separable from *H. clausi*, the only other small (TL less than 2.8 mm) member of the genus, in the female by the absence of an inner distal spine from the P5 expl, and in the male by the absence of a well-defined process on the lft P5 bp2, and the broad base of the process on the rt P5 bp2 (compared with a finger-like process with a narrow base for *H. clausi*). *H. papilliger* is also slightly shorter than *H. clausi* in total length.

Distribution and Occurrence:

Widely distributed, but rare, over the Atlantic, Indian and Pacific Oceans in deep water, although it may migrate to the surface at night (2). Locally, reported from Queen Charlotte Strait (3).

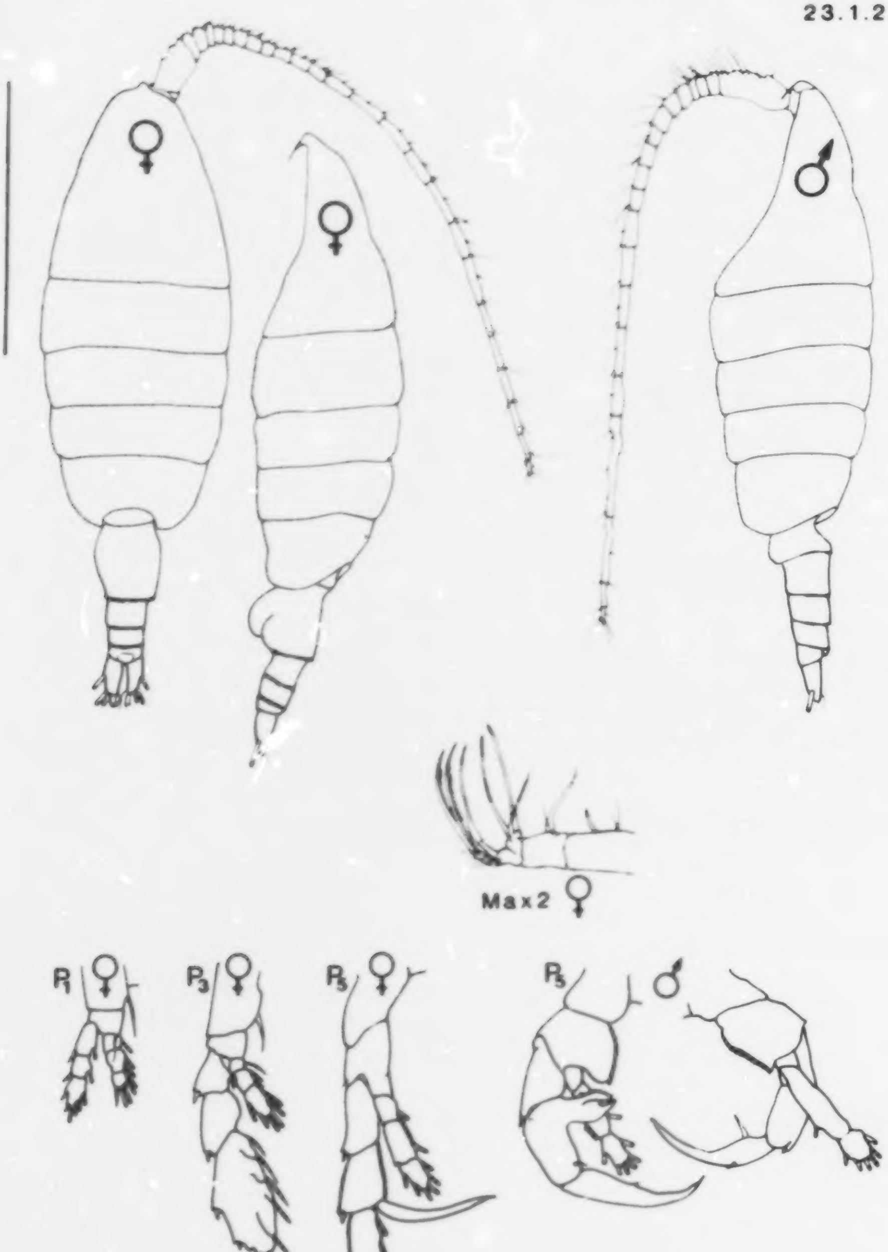
Life History:

Juveniles undescribed; however, the size of the CV female is recorded as 1.4-1.5 mm (2). Juveniles cannot be adequately separated from juveniles of *H. clausi*.

References:

1) Brodsky, 1950
2) Vervoort, 1965
3) Stone, 1980

23.1.2


♀
♀
♂
Max2 ♀
P1 ♀
P3 ♀
P5 ♀
P5 ♂

Heterorhabdus papilliger

from Mori,1937;Owre and Foyo,1967;Park,1968

23.1.3 Heterorhabdus robustoides Brodsky, 1950

Morphology:

Large copepods with PLC rounded but produced slightly backward; Ro of two thin filaments arising from an elongate base; Hd with shallow trench-like depression across middorsal line, visible in lateral view; A1 reach midpoint of Ur; Pro:Ur ratio approximately 2.0; CR elongate, slightly asymmetrical; masticatory edge of rt md with greatly enlarged lateral denticle, lateral denticle on lft md much smaller; mxp bpl with thin median spine. P1-P4 exp with very broad segments, exp3 with very short outer spines (1).

FEMALE TL 4.8-5.0 mm; gnsgt enlarged and equal to combined length of Ur2-Ur4. P5 rami three-segmented, exp2 with large spine arising from inner margin, rt exp2 with short, heavy, acute process arising from inner margin (1).

MALE TL 4.6-4.8 mm (1).

Separable from other local members of the genus by its large size, the rounded PLC which extend only slightly backwards, and the large denticle on the masticatory edge of the md, which is on the rt md in H. robustoides, but the lft md in H. robustus. Note, however, that in at least one case (2) the large denticle is described as being on the rt md in H. robustus. Tanaka (3) suggests that H. robustoides and H. robustus may be synonymous. We retain separate species, but suggest that type specimens be carefully compared.

Distribution and Occurrence:

Reported from the northwestern Pacific and Bering Sea (1).

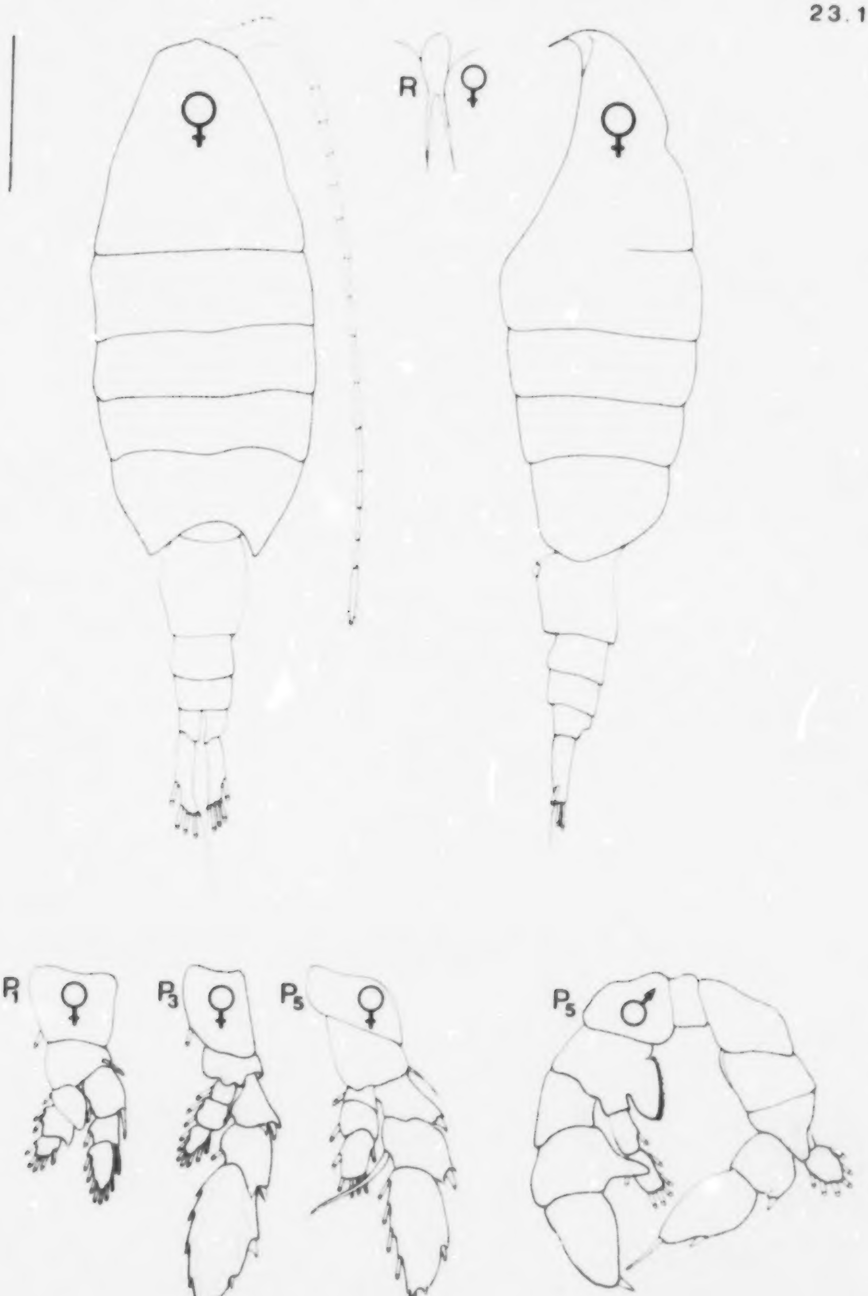
Life History:

Juveniles undescribed; however, the CV should be separable based on size, the placement of the enlarged denticle on the md, and the lack of a large median seta on the mxp bpl.

References:

1) Brodsky, 1950
2) Rose, 1933
3) Tanaka, 1964a

23.1.3



Heterorhabdus robustoides

from Brodsky, 1950

23.1.4 Heterorhabdus robustus Farran, 1908

Synonymy:

Heterorhabdus vipera: Farran (1905)

Morphology:

Pro:Ur ratio approximately 1.7; PLC rounded; masticatory edge of lft md with greatly enlarged lateral tooth; max2 with distal setae strongly developed and spine-like; CR elongate; mxp bpl with a thin, median spine (1, 2).

FEMALE TL 3.83-4.75 mm (1) (3.05-3.70 (3)); A1 reaches midpoint of Ur. P5 exp2 with large inner edge spine equal in length to length of exp3 (1, 2).

MALE TL 3.45-4.90 mm; A1 reaches ansgt; rt P5 exp2 with large process on inner margin, bp2 with small inner marginal process; lft P5 bp2 without process or spinules (1, 2).

Separable from other members of the genus by size, the rounded PLC, the thin spine on the mxp bpl (compared with a thick seta in H. tanneri) and the asymmetry of the mandibular denticles, the largest being on the lft md (cf. the rt md for H. robustoides) Note, however, that in at least one case (4) the larger denticle is described as being on the rt md in H. robustus. Tanaka (1) suggests that H. robustus and H. robustoides may be synonymous. We retain separate species, but suggest that type specimens be carefully compared.

Distribution and Occurrence:

Widely distributed in the Atlantic, found in various locations in the Pacific, but not widespread there (3). Locally, reported in the Strait of Juan de Fuca (5).

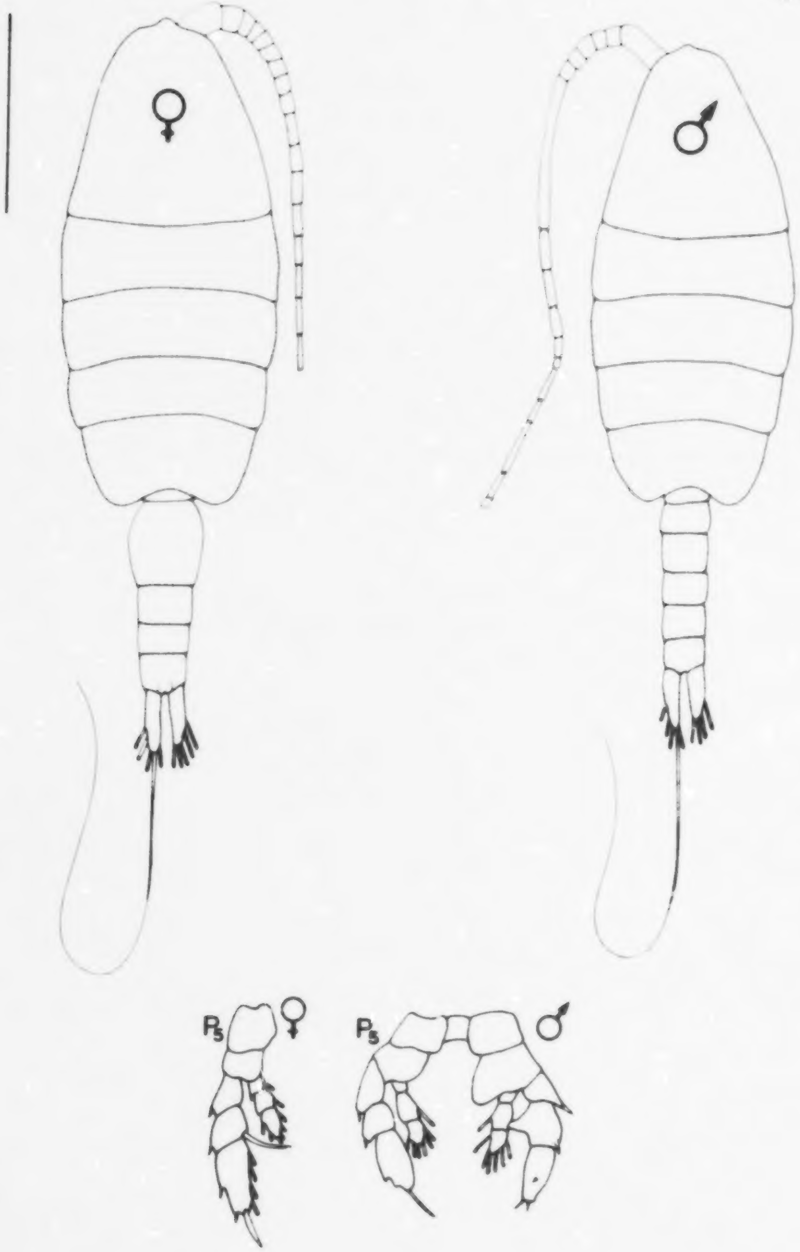
Life History:

Juveniles undescribed; however, the CV and perhaps the CIV should be separable by the presence of a large tooth on the masticatory edge of the lft md and the absence of such a tooth on the rt md.

References:

1) Tanaka, 1964a
2) Farran, 1948f (Fiches, Sheet 16)
3) Vervoort, 1965
4) Rose, 1933
5) Chester et al., 1980

23.1.4



Heterorhabdus robustus

From Rose, 1933

23.1.5 Heterorhabdus spinifrons (Claus, 1863)

Synonymy:

Heterochaeta spinifrons: Giesbrecht (1892)

Morphology:

Pro:Ur ratio approximately 2.2; A1 exceeds TL; dorsal papilla produced into a small spine (1, 2, 3).

FEMALE TL 2.8-3.5 mm; P5 exp2 inner distal spine is about as long as exp3 (1, 2, 3).

MALE TL 2.8-3.2 mm; rt P5 bp2 with inner process having a notched margin; lft P5 bp2 with rounded, fringed inner margin (1, 2, 3).

Separable from all other members of the genus by the spinous extension of the dorsal papilla.

Distribution and Occurrence:

Widely distributed, reported from the Atlantic, Pacific and Indian Oceans, and the Norwegian and Mediterranean Seas (1). Locally, reported from Queen Charlotte Strait (4).

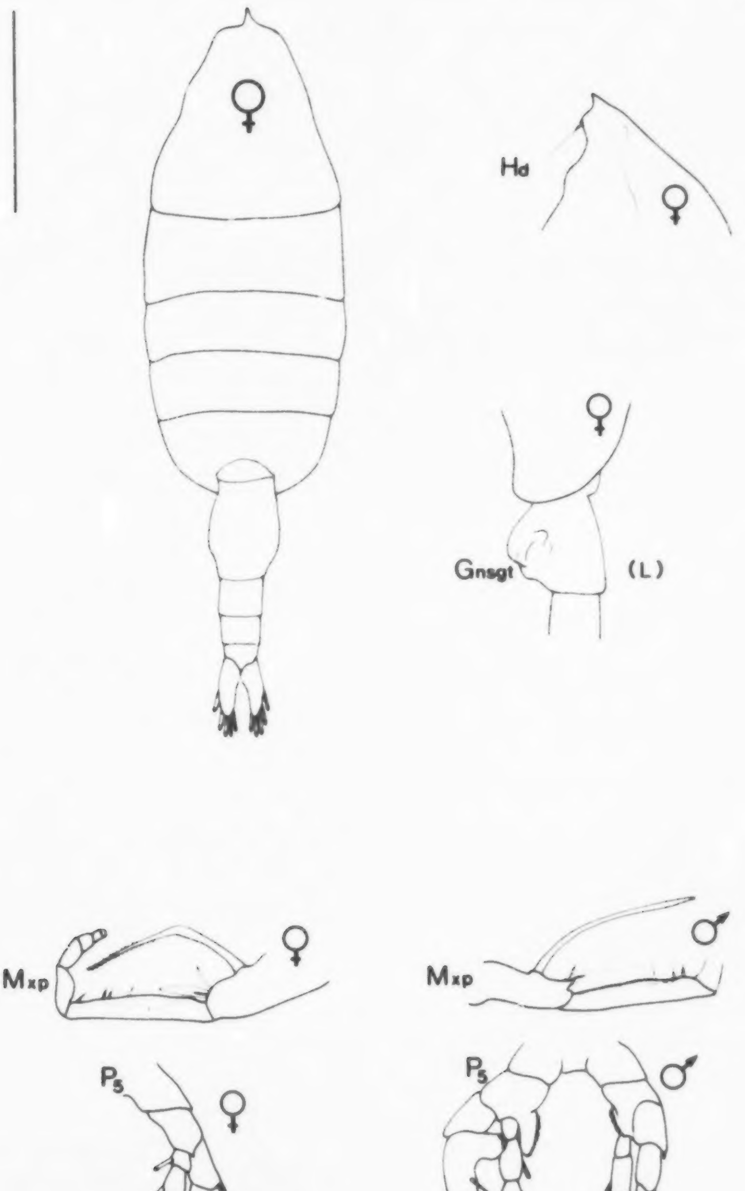
Life History:

Juveniles undescribed; however, the spinous extension of the papilla should allow the identification of the CV and probably CIV.

References:

1) Brodsky, 1950
2) Tanaka, 1964a
3) Vervoort, 1965
4) Stone, 1980

23.1.5


♀
Hd
♀
♀
Gnsgt
(L)
Mxp
♀
Mxp
♂
P_5
♀
P_5
♂

Heterorhabdus spinifrons

from Giesbrecht,1892; Esterly,1905; Tanaka,1964

23.1.6 Heterorhabdus tanneri (Giesbrecht, 1895)

Synonymy:

Heterorhabdus proximus: Davis (1949b); Cameron (1957)
H. pilosus: Tanaka (1953)

Morphology:

A1 longer than TL by two or more segments; masticatory edges of rt and lft md similar in appearance; mxp bpl armed medially with a stout seta (1, 2).

FEMALE TL 3.2-4.1 mm; PLC with short, small wing-shaped processes in lateral view; Pro:Ur ratio approximately 2.1; gnsgt enlarged, longer than Ur2, 3 and 4 combined; ventral process of gnsgt blunt and protruding in lateral view. Single caudal seta on lft CR 3x TL. Inner distal corner of P5 exp2 with stout spine about 2/3 the length of exp3 (1, 2).

MALE TL 3.0-3.9 mm; lft A1 geniculate. rt P5 bp2 with a finger-like projection arising from inner margin, exp1 with a small, inner process bearing a short spine (1, 2).

This species is separable from other members of the genus by the lack of a spine on the dorsal papilla, the symmetry of the masticatory edges of the md's, and the presence of a stout medial seta on the mxp bpl.

Distribution and Occurrence:

Northwestern Pacific Ocean, Sea of Okhotsk, and Bering Sea (1). Locally, deep and rare in the Strait of Georgia (3) and reported also from the vicinity of the Queen Charlotte Islands (4).

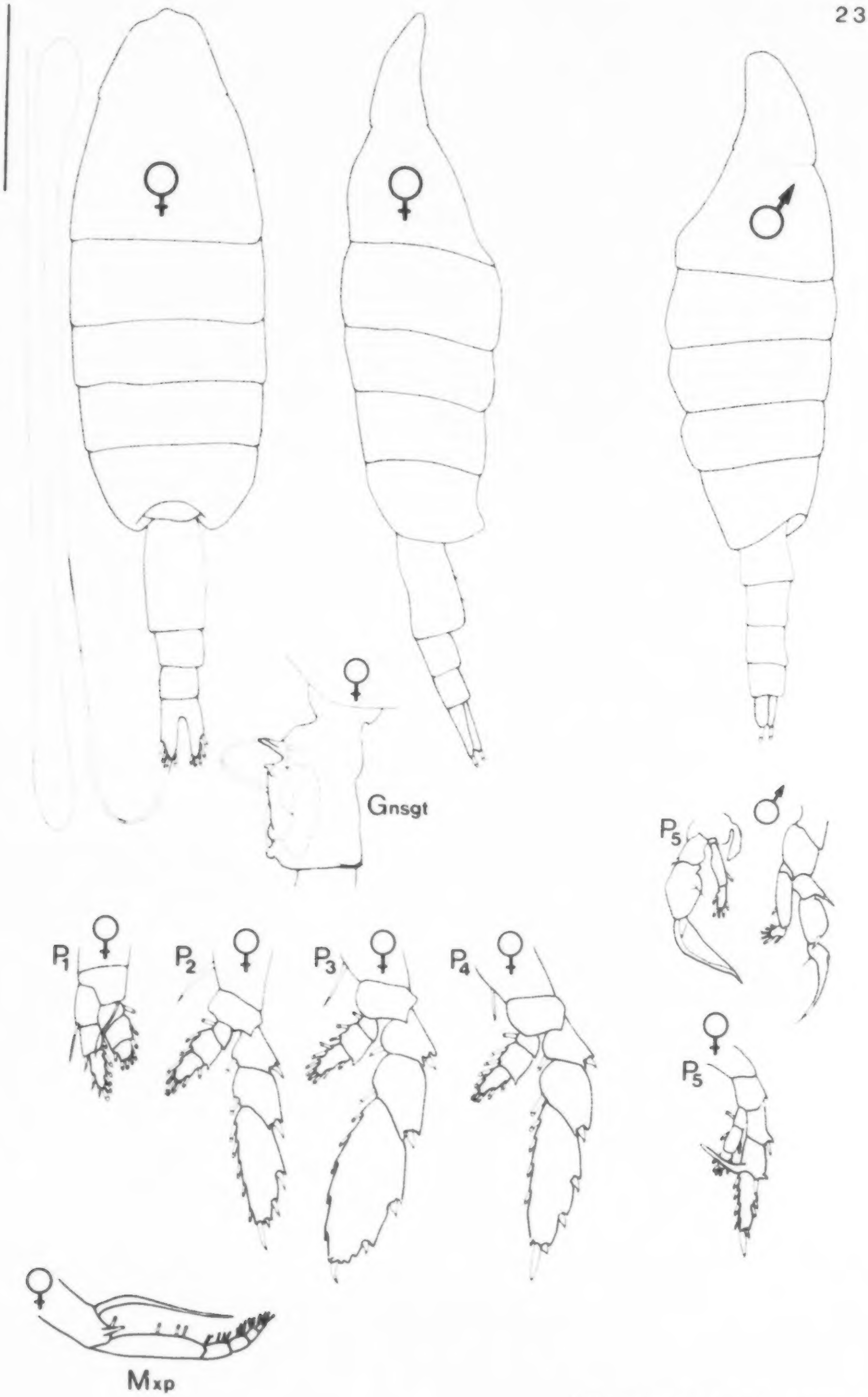
Life History:

Juveniles undescribed, but the characters which separate the species from other members of the genus should also be valid for the CIV and CV.

References:

1) Brodsky, 1950
2) Tanaka, 1964a
3) Fulton, 1972
4) Cameron, 1957

23.1.6


♀
♀
♂
♀
Gnsgt
P5
♂
P1 ♀
P2 ♀
P3 ♀
P4 ♀
♀
P5
♀
Mxp

Heterorhabdus tanneri

from Koeller, 1974

23.2 Heterostylites Sars, 1920

Morphology:

Hd blunt, with clearly visible dorsal papilla; A1 longer than TL; A2 rami unequal; large denticle on masticatory edge of md not separated from other teeth; distal part of max2 reduced, lacking large spines; CR slightly unequal, with elongate seta on lft CR (1, 2).

FEMALE gnsgt protruding ventrally. P5 biramous, symmetrical, exp/enp 3-3. P5 exp2 with long spine; complex crest of fused spines near base of outer spine (1, 2).

MALE P5 biramous, asymmetrical; exp, enp 3-3; rt P5 exp2 inflated on inner margin, but without defined process (1, 2).

	Heterostylites	Heterorhabdus	Euchaeta
P1, P2 segmentation	3-3/3-3	3-3/3-3	2(3)-1/3-1
Max2 distal setae	reduced	thick, stout	#
A1	longer than TL	usually less than TL	#
Mxp masticatory edge lateral tooth	not separated	set off by gap	#

References:

1) Brodsky, 1950
2) Farran, 1948e (Fiches, Sheet 15)

23.2.1 Heterostylites longicornis (Giesbrecht, 1889)

Morphology:

A1 exceeds TL by several segments; A2 rami subequal; max2 with one large curved spine distally; mxp bp1 without large, stout median seta (1, 2, 3, 4).

FEMALE TL 2.3-3.5 mm; P5 exp2 outer edge spine with a row of smaller spines near its base, inner edge spine long and thin (1, 2, 3, 4).

MALE TL 2.7-3.5 mm; lft A1 geniculate; rt P5 bp2 with long, finger-like process on inner margin, exp2 greatly widened (1, 2, 3, 4).

Separable from H. major, the other local member of the genus, by size (less than 3.7 mm for H. longicornis) and the length of the A1 (exceeds TL, but not by as many segments as in H. major).

Distribution and Occurrence:

Reported from the Atlantic and Pacific Oceans, including the coast of California (2). Locally, reported from Queen Charlotte Strait (5) and the Strait of Juan de Fuca (6).

Life History:

The CV male has been briefly described from a 3.3 mm specimen (1). The Ur is four-segmented, the A1 elongate, and the P5 has two-segmented rami only slightly modified from the regular swimming legs. The other stages have not been described, but the characters used in the key should be sufficient for identification of the CV and possibly CIV.

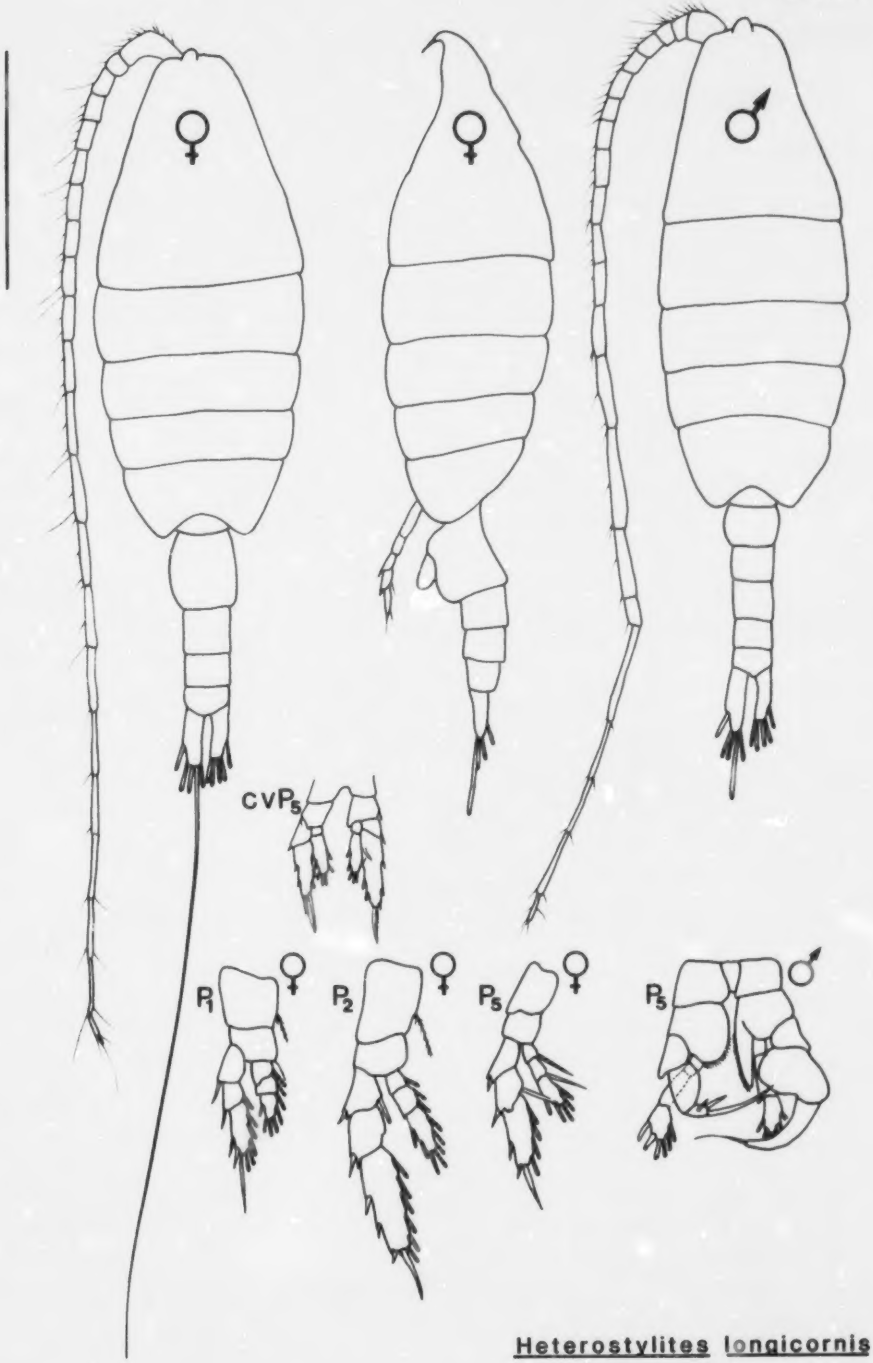
Comments:

Some authors consider the large species of H. major to be a size variant of H. longicornis (1). Rare in the study site, and may indicate intrusions of equatorial water (7).

References:

1) Tanaka, 1964a
2) Brodsky, 1950
3) Vervoort, 1965
4) Farran, 1948e (Fiches, Sheet 15)
5) Stone, 1980
6) Chester et al., 1980
7) Gardner, 1982a

23.2.1


♀
♀
♂
CVP5
P1 ♀
P2 ♀
P5 ♀
P5 ♂

Heterostylites longicornis

from Sars,1925; Tanaka,1964

23.2.2 *Heterostylites major* (Dahl, 1894)

Synonymy:

Heterorhabdus major: Wolfenden (1911)

Morphology:

Pro:Ur ratio approximately 1.8-2.0; A1 longer than TL by at least five segments; max 2 with only one heavy, curved seta distally, the rest of normal size (1, 2, 3, 4).

FEMALE TL 4.0-5.2 mm; gnsgt comparatively short; CR asymmetrical, lft longer than rt. P5 exp2 inner spine thin and elongate, longer than exp3, outer spine with basal crest composed of several cusps (1, 2, 3, 4).

MALE TL 3.8-5.4 mm; lft A1 geniculate; rt P5 exp2 much wider than long, and with a denticulate apex, bp2 with a long, finger-like projection from its inner margin; lft P5 projecting anteriorly along the inner margin (1, 2, 3, 4).

Separable from *H. longicornis*, the only other local member of the genus, by its larger size (TL exceeds 3.7 mm) and longer A1.

Distribution and Occurrence:

Reported from the northwestern Pacific, North Atlantic, Bering Sea, Sea of Okhotsk, Davis Strait, Baffin Bay and Antarctic (1). Locally, reported from the Strait of Juan de Fuca (5).

Life History:

Juveniles undescribed; however, the CV should be separable based on size and the elongate A1.

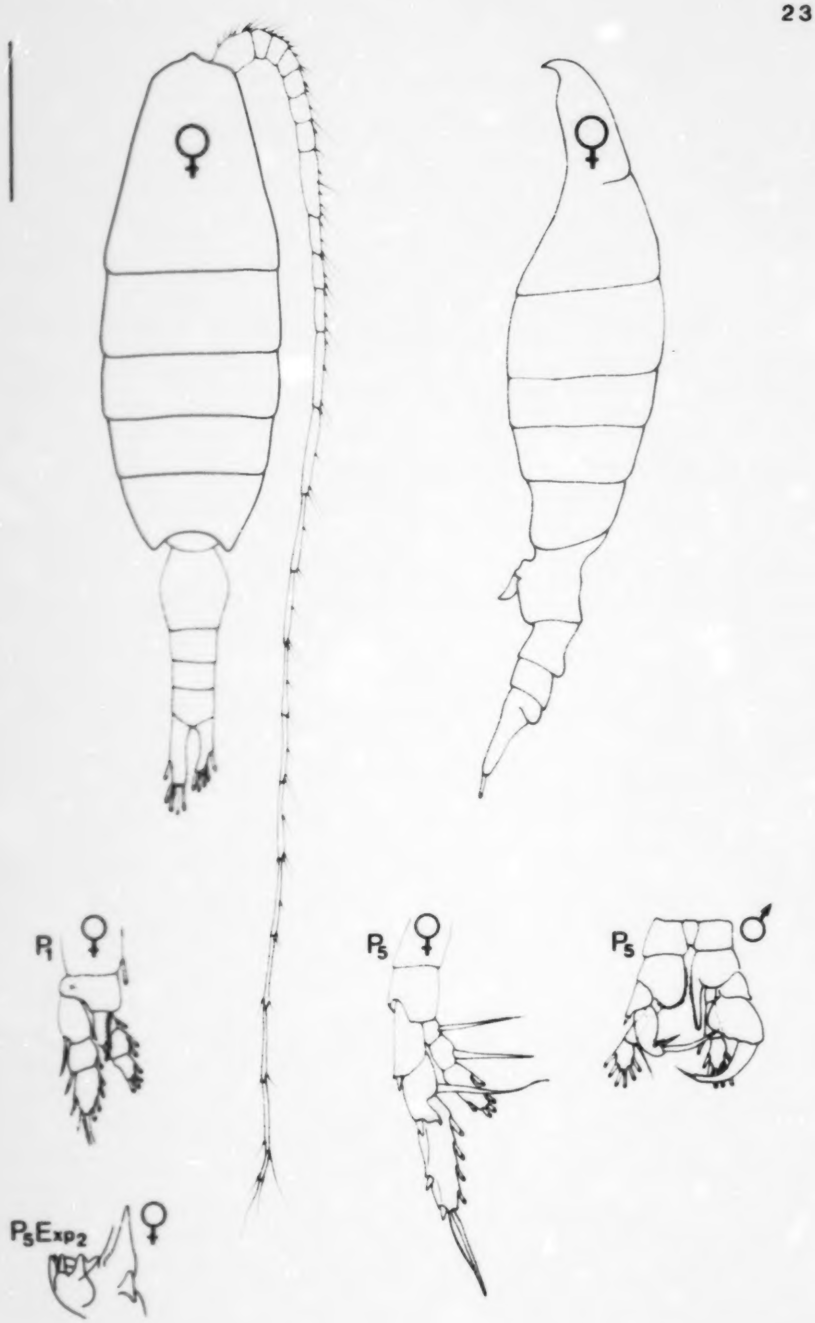
Comments:

Some authors question the validity of *H. major*, and suggest that it may be a size variant of *H. longicornis* (2).

References:

1) Brodsky, 1950
2) Tanaka, 1964a
3) Vervoort, 1965
4) Farran, 1948e (Fiches, Sheet 15)
5) Chester et al., 1980

23.2.2


♀
♀
P1 ♀
P5 ♀
P5 ♂
P5Exp2 ♀

Heterostylites major

from Sars,1925, Tanaka,1964

24.1 Centraugaptilus Sars, 1920

Morphology:

Large to very large copepods; Ro heavily chitinized, in form of a notched plate directed downward or obliquely downward and forward; A1 shorter than Pro; mxp masticatory edge with two long, thin denticles and one shorter, median denticle; some distal setae of mxp curled over at the tip and bearing shield-shaped structures distally. CR short; Ur short; P5 biramous with two- or three-segmented rami (1, 2).

FEMALE Ur three-segmented; P5 exp usually three-segmented (1, 2).

MALE Ur five-segmented; P5 asymmetrical, exp with two or three segments (1, 2).

The local species of this genera is the only calanoid with total body spination found in the study area.

References:

1) Brodsky, 1950
2) Owre and Foyo, 1967

24.1.1 Centraugaptilus porcellus Johnson, 1936

Morphology:

Pro broad, especially in the female; surface of body and appendages spinulose; Ro two rotund, widely-separated rami which are enlarged near their base; AI short; Ur very short; masticatory edge of md with one short median tooth and two long lateral teeth. P1,2 segmentation: 3-2/3-3 (1, 2).

FEMALE TL 6.0-6.2 mm; Ro not visible in dorsal view; Ur three-segmented (1, 2).

MALE TL 5.75 mm; lft AI genicualte, Ro visible in dorsal view. P5 bp2 with small spinous protuberance on inner edge (1, 2).

Within the study area, only one other species has a densely spinulose body surface, the cyclopoid Pseudolubbockia dilatata.

Distribution and Occurrence:

Reported only from the North Pacific (1). Locally, reported from Queen Charlotte Strait (3).

Life History:

Juveniles undescribed; however, the characteristic body spination and pronounced Ro should allow identification of the CV and CIV.

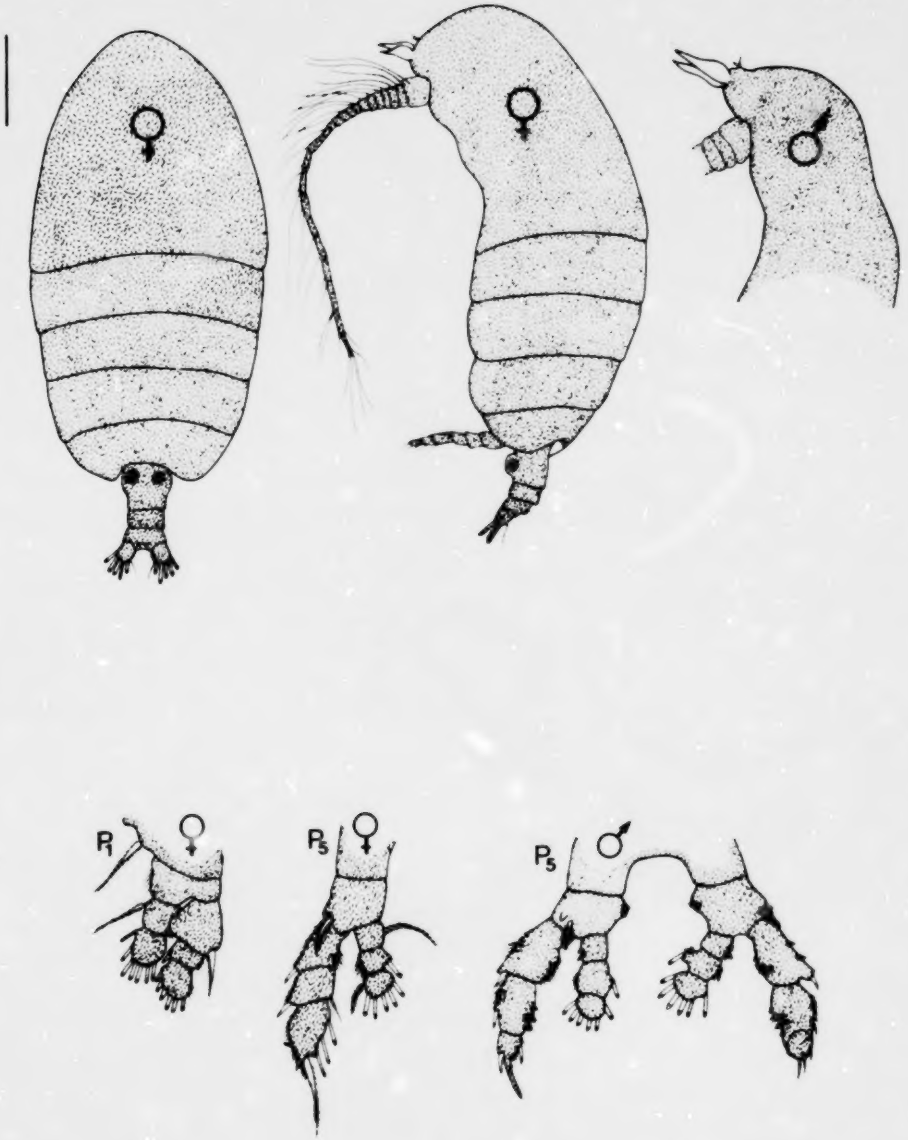
Comments:

Centraugaptilus porcellus is the only species of the genus which has been reported from the study area.

References:

1) Brodsky, 1950
2) Johnson, 1936
3) Stone, 1980

24.1.1



Centraugaptilus porcellus

from Johnson, 1936

24.2 Haloptilus Giesbrecht, 1898

Synonymy:

Hemicalanus (part): Claus (1863)

Morphology:

Hd profile occasionally papillate; Ro of two thin filaments; thorax usually four-segmented. Ur short; A2 enp much longer than exp; masticatory edge of md with two large denticles; max2 reduced; mxp with large enp; P5 biramous, exp, enp three-segmented (1).

FEMALE Ur four-segmented; P5 exp2 usually with elongate inner setae (1).

MALE Ur five-segmented; lft A1 geniculate; P5 rami not greatly modified (1).

	Haloptilus	Gaetanus
P1 enp segmentation	3	1
Th segmentation	4, 5	3

References:

1) Brodsky, 1950

24.2.1 Haloptilus oxycephalus (Giesbrecht, 1889)

Synonymy:

Hemicalanus oxycephalus: Giesbrecht (1892)

Morphology:

Ur short; A1 longer than TL; A2 exp twice length of A2 enp (1, 2, 3, 4, 5).

FEMALE TL 3.0-4.1 mm; Hd with elongate, apical spine; Pro:Ur ratio about 6; each PLC produced into a long spine. P5 absent (2).

MALE TL 2.5-2.9 mm; Hd rounded. P5 biramous, asymmetrical; exp-enp segmentation 3-3; lft bpl inner margin with hook. Exp armed with spines but devoid of setae (3).

Distribution and Occurrence:

Reported from the tropical Pacific, Mediterranean Sea and Atlantic Ocean (1, 4). Locally, reported from Queen Charlotte Strait (5).

Life History:

Juveniles undescribed; however, the head spine and short Ur should allow identification of the CV and probably CIV.

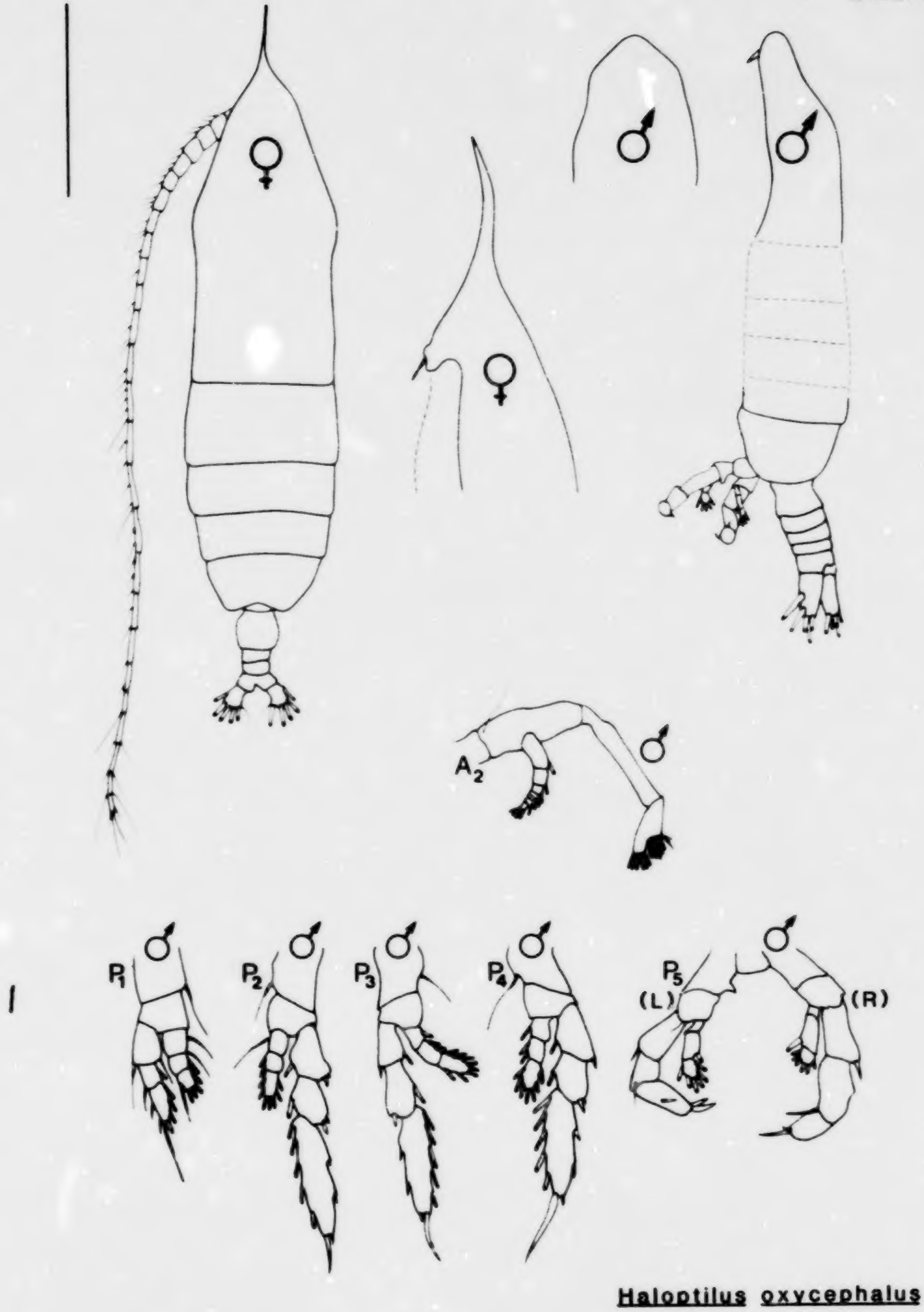
Comments:

The only species of the genus Haloptilus reported from the study area.

References:

1) Mori, 1937
2) Tanaka and Omori, 1971
3) Vervoort, 1957
4) Vervoort, 1965
5) Stone, 1980

24.2.1


♀
♀
♂
♂
A2
♂
♂
P1
♂
P2
♂
P3
♂
P4
♂
P5
(L)
(R)

Haloptilus oxycephalus

from Sars, 1925; Vervoort, 1957

24.3 Pachyptilus Sars, 1920

Morphology:

Pro wide; PLC rounded; A1 longer than TL; Ro two filaments arising from a basal plate; labrum large; masticatory edge of mandible widened, with many well-developed denticles (1).

FEMALE Ur four-segmented; exp/enp broad, segmentation 3-1 (1).

MALE P5 biramous; exp, enp 3-3 (1).

	Pachyptilus	Lucicutia
P5 enp segmentation	1	3
TL (mm)	5.8-6.3	1.2-1.8

References:

1) Brodsky, 1950

24.3.1 Pachyptilus pacificus Johnson, 1936

Morphology:

FEMALE TL 5.8-6.3 mm; Ur short, four-segmented; A1 exceeds TL; Ro of two long filaments; PLC with angular profile; masticatory edge of md broad, with one large, lateral tooth separated from the other teeth. P1,2 segmentation: 3-2/3-3; P5 biramous with three-segmented exp and one segmented enp (1, 2).

MALE Undescribed.

Easily separated from the smaller Lucicutia ovalis (TL 1.2-1.8 mm) but similar in general body shape and A1 length.

Distribution and Occurrence:

Northwestern Pacific Ocean, Bering Sea (1). Locally, reported from Queen Charlotte Strait (3).

Life History:

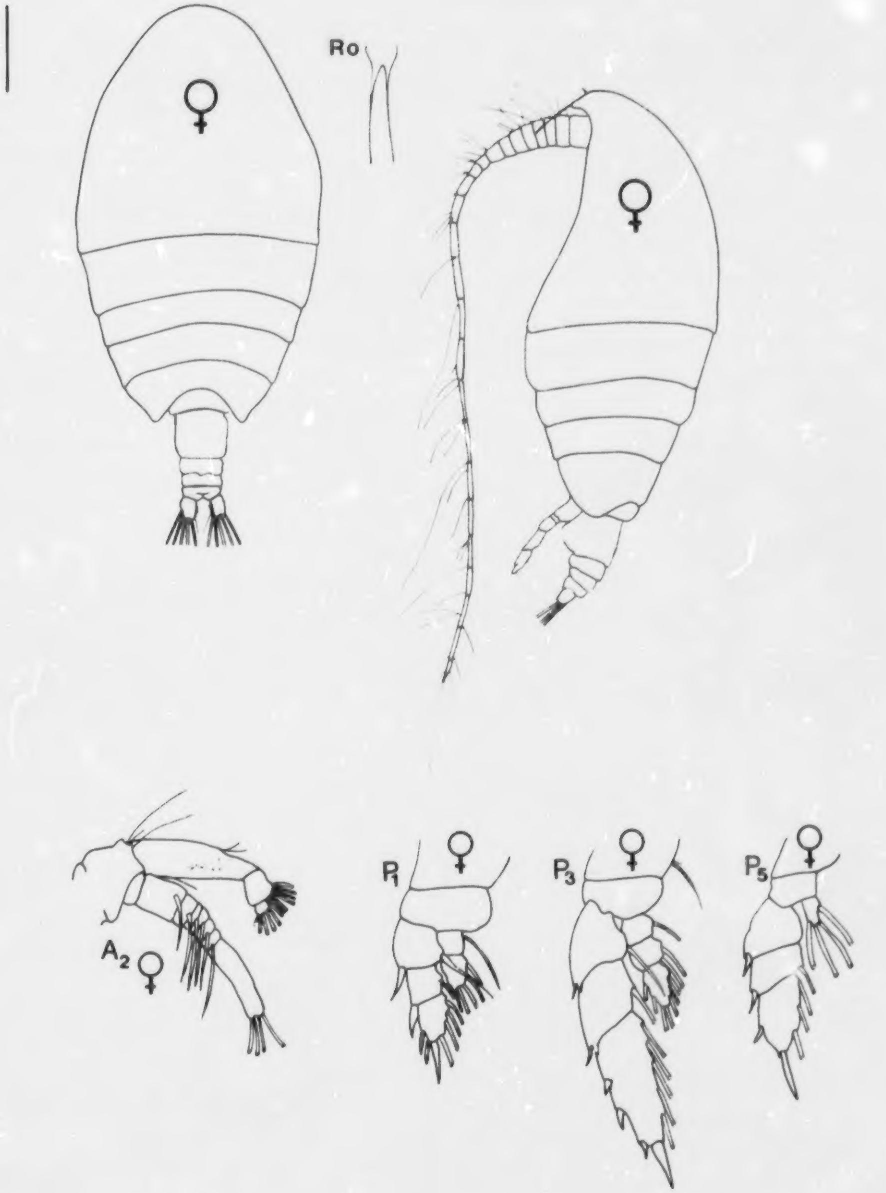
Juveniles undescribed; however, the broad Pro, short Ur and long A1 should allow identification in the CV.

Comments:

The only local member of the genus Pachyptilus.

References:

1) Brodsky, 1950
2) Johnson, 1936
3) Stone, 1980


♀
Ro
♀
A₂ ♀
P₁ ♀
P₃ ♀
P₅ ♀

Pachyptilus pacificus

from Johnson, 1936

25.1 Arietellus Giesbrecht, 1892

Morphology:

Large copepods, with Hd usually apically acute; PLC elongate, often acute; Ro two thin filaments; A1 short; A2 enp longer than exp; max2 with prominent spines. P1,2 segmentation 3-3/3-3 (1).

FEMALE P5 uniramous, reduced, three-segmented (1).

MALE lft A1 geniculate; P5 biramous, but enp rudimentary (1).

	Arietellus	Scottocalanus	Lophothrix
Ro massive	n	y	y
P1 expl spine	y	y	n
A2 rami subequal	y	n	y
P1, 2 segmentation	3-3/3-3	3-1/3-2	3-1/3-2

References:

1) Brodsky, 1950

25.1.1 Arietellus plumifer Sars, 1905

Morphology:

Hd with sharp apical process visible in lateral view; PLC elongate with acute tips which may curve to a point directed postero-dorsally; Ro of two thin filaments; A1 short; A2 enp longer than exp (1, 2, 3).

FEMALE TL 4.6-5.6 mm; P5 uniramous, three-segmented, 2P5 widened at distal edge (1, 2, 3).

MALE TL 5.0-5.9 mm; A1 geniculate. P5 biramous with rudimentary enp, exp three-segmented (1, 2, 3).

Characterized by the relatively thin Ro, the dominance of the enp in the A2 and the presence of three-segmented rami in P1-P4. Separable from other medium-sized copepods by the distinctive P5 (male and female).

Distribution and Occurrence:

Widely distributed in the North Atlantic from about 4^{o}N to 70^{o}N; also reported from the Indo-Pacific and the central and eastern Pacific Ocean (3). Locally, reported from Queen Charlotte Strait (4).

Life History:

Juveniles undescribed; however, the characters used to identify the species should also be valid for at least the CV.

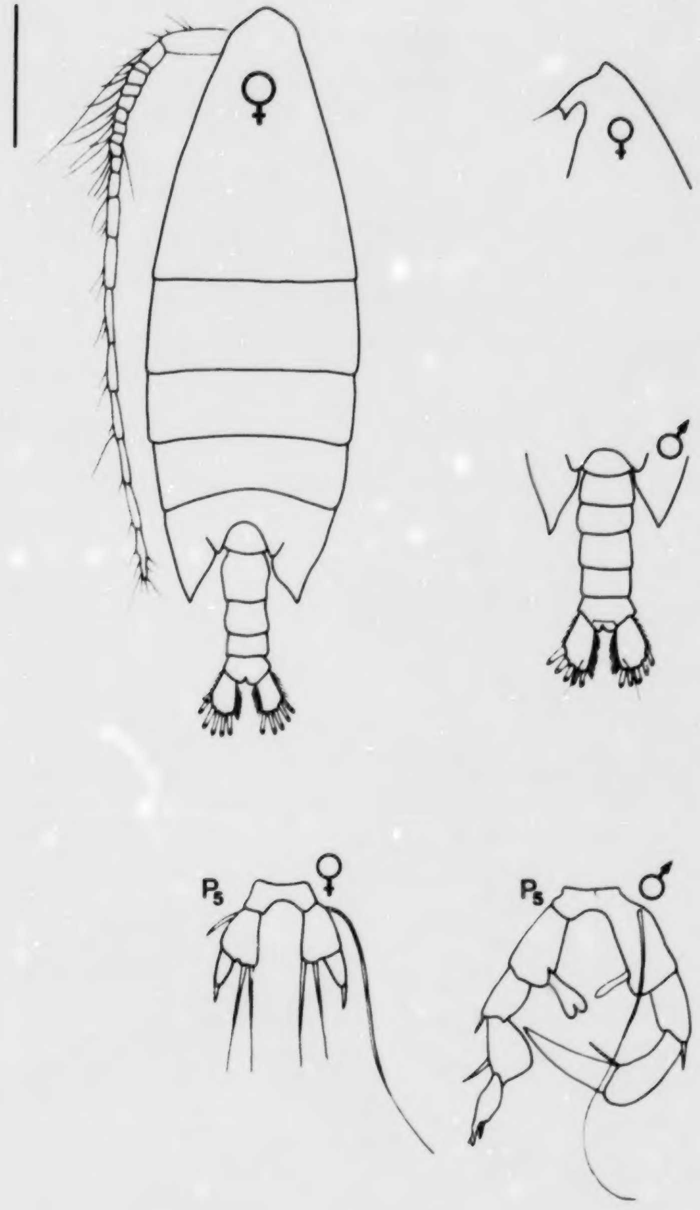
Comments:

This is the only species of Arietellus reported from the study area.

References:

1) Rose, 1933
2) Grice, 1962
3) Vervoort, 1965
4) Stone, 1980

25.1.1



Arietellus plumifer

from Sars,1925

25.2 Phyllopus Brady, 1883

Morphology:

Copepods of moderate size; gnsgt sometimes asymmetrical; A1 short; A2 enp much shorter than exp; labrum large and protruding (1).

FEMALE Ur four-segmented; P5 uniramous, five-segmented; 3P5 with long, thin inner bristle (1).

MALE lft A1 geniculate; Ur five-segmented; lft P5 with large enp, rt P5 uniramous (1).

Separable from other medium-sized copepods by the distinctive P5 (male and female).

References:

1) Brodsky, 1950

25.2.1 Phyllopus integer Esterly, 1911

Synonymy:

Phyllopus bidentatus: Esterly (1905)

Morphology:

PLC elongate, acute, somewhat asymmetrical in lateral view due to a small depression on dorsal side of apex; Ro single, short, massive; A1 short; gnsgt half length of Ur. P1,2 segmentation: 3-3/3-3 (1, 2).

FEMALE TL 3.53 mm (1, 2).

MALE TL 2.64 mm; lft P5 distal segment extremely broad (1).

Distribution and Occurrence:

Reported from the Pacific Ocean near the coast of California (2). Locally, reported from Queen Charlotte Strait (3).

Life History:

Juveniles undescribed; key valid for adults only.

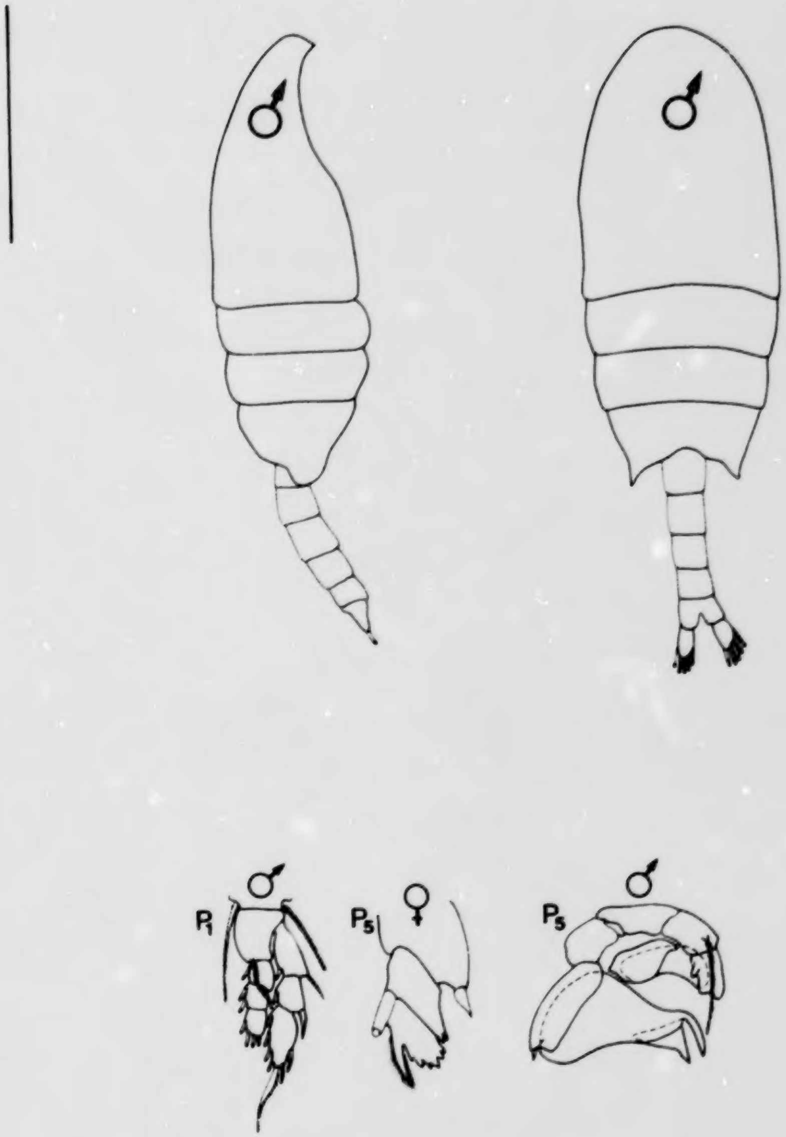
Comments:

This is the only species of Phyllopus reported from the study area. Esterly's earlier (4) report of this species as P. bidentatus is doubtful due to the much smaller size of his specimens (2.2 mm TL).

References:

1) Esterly, 1911
2) Brodsky, 1950
3) Stone, 1980
4) Esterly, 1905

25.2.1



Phyllopus integer

from Esterly,1911

26.1 Candacia Dana, 1846

Morphology:

Hd blunt, with conspicuous construction in dorsal view; PLC spiniform, often asymmetrical; gnsgt often spinous and/or asymmetrical. CR short; max2 modified, armored distally with one or two large, scythe-shaped bristles; mxp reduced; masticatory edge of mandible with basal tooth divided into one or more pointed cusps (1, 2).

FEMALE Ur three-segmented; P5 uniramous, symmetrical, three-segmented with serrate outer margin (1, 2).

MALE Ur five-segmented; P5 uniramous, asymmetrical; rt P5 three-segmented with bifid terminal segment; lft P5 two-segmented (1, 2).

The unusually blunt Hd shape, large max2 and gnsgt separate this genus from other local copepods.

References:

1) Brodsky, 1950
2) Grice, 1963

26.1.1 Candacia bipinnata (Giesbrecht, 1889)

Synonymy:

Candace truncata: Brady (1883)
Candacia pectinata: Esterly (1905); Mori (1937)

Morphology:

A small copepod with a blunt Hd constricted at its base in dorsal view; max2 enlarged and armed distally with several stout, scythe-like setae; PLC acute (1, 2, 3, 4).

FEMALE TL 2.2-2.7 mm; gnsgt with acute lateral projections; P5 lacking deep apical notches (1, 2, 3, 4).

MALE TL 2.1-2.5 mm; rt PLC larger than lft and extended further distally; gnsgt with acute lateral projection on rt side only; rt P5 shorter than lft (1, 2, 3, 4).

The female of the other local species, C. columbiae, has no gnsgt lateral projections and the male has a much longer single gnsgt lateral projection. C. bipinnata is smaller in size.

Distribution and Occurrence:

Widely distributed in the Atlantic, Pacific and Indian Oceans (4). Locally, reported from Queen Charlotte Strait (5) and rare in the Strait of Georgia (6).

Life History:

Juveniles undescribed; however at least the CV should be identifiable based on the well-armed max2.

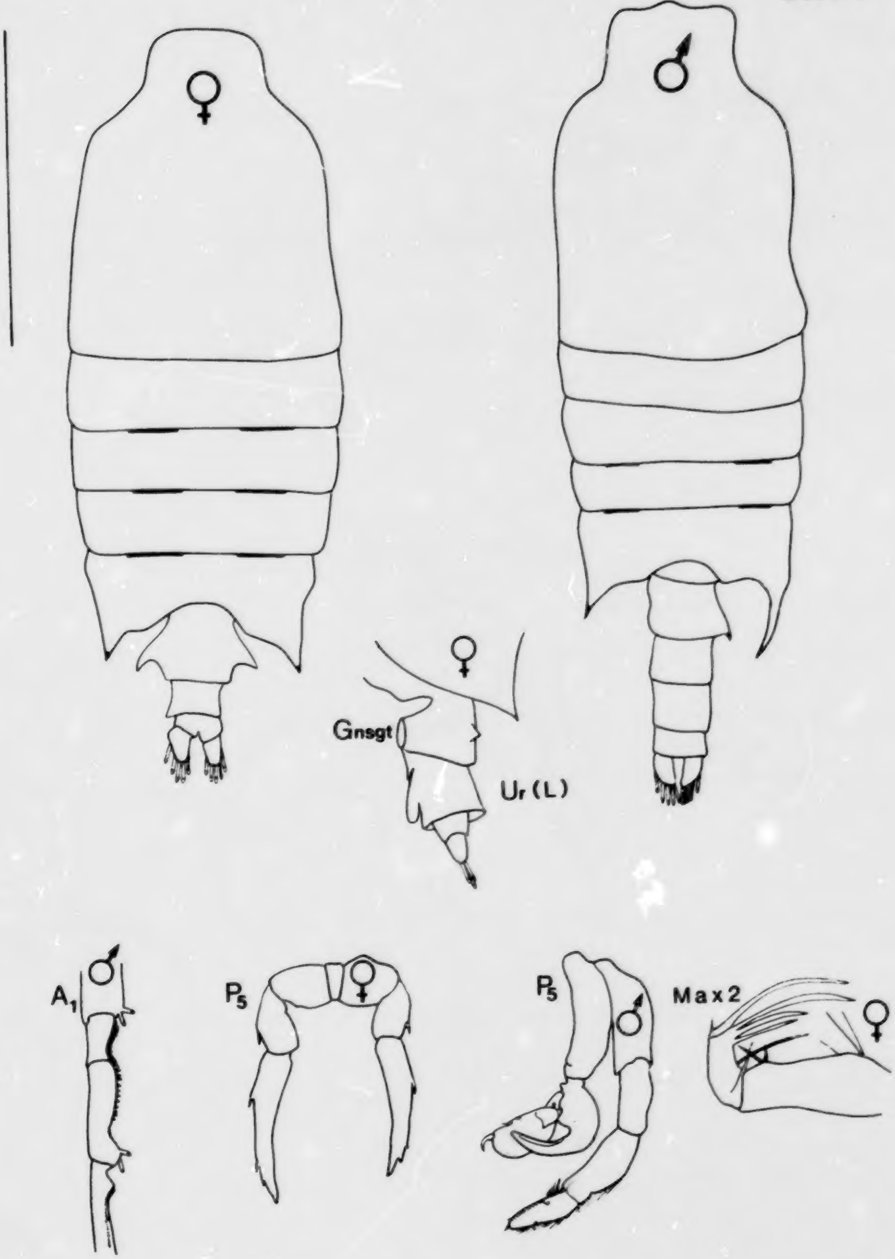
Comments:

Rare in the study area, and may indicate intrusions of equatorial water (7).

References:

1) Mori, 1937
2) Grice, 1963b
3) Tanaka, 1964c
4) Vervoort, 1965
5) Stone, 1980
6) Fulton, 1972
7) Gardner, 1982a

26.1.1



♀
♂
♀
Gnsgt
Ur (L)
A1 ♂
P5 ♀
P5 ♂
Max2 ♀

Candacia bipinnata

from Brodsky, 1950, 1962

26.1.2 *Candacia columbiae* Campbell, 1929

Synonymy:

Candacia pacifica: Mori (1937)

Morphology:

Hd blunt, constricted at base in dorsal view; A1 long; max2 armed distally with several heavy, scythe-like setae; gnsgt asymmetrical on rt side (1, 2, 3).

FEMALE TL 3.7-4.1 mm; P5 uniramous, segmented, distal segment elongate and with a deeply notched apex (1, 2, 3).

MALE TL 3.2-4.5 mm; gnsgt with complex, thin, apically bifurcate projection arising from lateral margin and extending perpendicular to the long axis of the Ur; rt PLC elongate and directed medially (1, 2, 3).

The female of the other local species, *L. bipinnata*, has two gnsgt lateral projections and the male has a single reduced lateral projection. *C. columbiae* is larger in size.

Distribution and Occurrence:

Northwestern Pacific, Bering Sea, and Sea of Okhotsk (2). Locally, deep and rare. Originally reported from the west coast of Vancouver Island (1), and more recently from the Strait of Georgia (4) and the Queen Charlotte Islands (5).

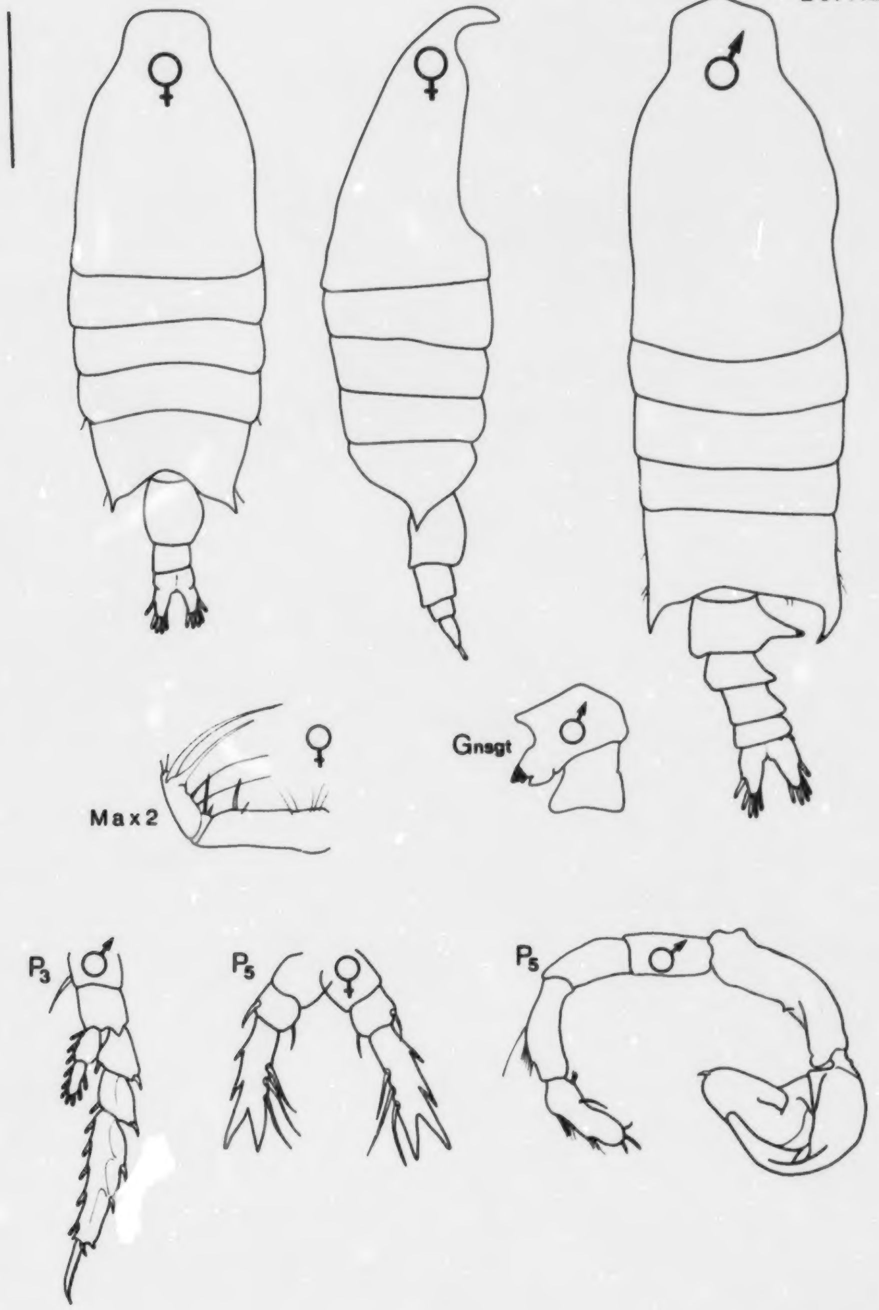
Life History:

Juveniles undescribed; however, at least the CV should be identifiable based on size, the constricted Hd profile and the well-armed max2.

References:

1) Campbell, 1929b
2) Brodsky, 1950
3) Grice, 1963b
4) Legare, 1957
5) Cameron, 1957

26.1.2


♀
♀
♂
Max 2
♀
Gnsgt
♂
P3
♂
P5
♀
P5
♂

Candacia columbiae

from Campbell, 1929; Brodsky, 1950

27.1 Epilabidocera Wilson, 1932

Synonymy:

Paralabidocera: McMurrich (1916)

Morphology:

Hd with pair of cuticular lenses visible in dorsal view; Hd armed laterally with backward directed hooks; Ro prominent, with strong filaments; PLC spinous or with acute, often asymmetrical, processes; ansgt short; P1,2 segmentation: 3-3/3-2 (1).

FEMALE Cuticular lenses small, Ur three-segmented; Ur and CR asymmetrical; P5 bp with two segments. Exp and enp symmetrical, one-segmented, often rudimentary (1).

MALE Cuticular lenses large; rt A1 geniculate; Ur four- or five-segmented; P5 uniramous, asymmetrical, four-segmented, chelate; lft P5 with rudimentary enp (1).

The distinctive PLC cuticular lenses and Ro separate this genus from all other local calanoids.

References:

1) Brodsky, 1950

27.1.1 *Epilabidocera longipedata* (Sato, 1913)

Synonymy:

Epilabidocera amphitrites: Davis (1949b); Brodsky (1950); Cameron (1957); Legare (1957); Fulton (1968, 1972)
Paralabidocera amphitrites: McMurrich (1916); Willey (1920); Esterly (1924); Campbell (1929b)

Morphology:

Hd with two cuticular lenses; AI and Ur short (1, 2).

FEMALE TL 3.2-4.0 mm; cuticular lenses small; PLC asymmetrical, sometimes with an acute spine on lft PLC. P5 biramous, one-segmented exp and enp (1, 2).

MALE TL 2.3-3.0 mm; cuticular lenses large; PLC acute and asymmetrical, rt PLC thinner and longer. rt A1 geniculate; rt P5 chelate (1, 2).

Distribution and Occurrence:

Coastal in the North Pacific (1). Locally, common and surface living; reported from the Strait of Georgia (1, 3) and the Queen Charlotte Islands (4).

Life History:

All naupliar and juvenile copepodite stages have been described (5). The paired eyes and lateral head hooks identify all copepodite stages except the CI.

Total Length (mm):

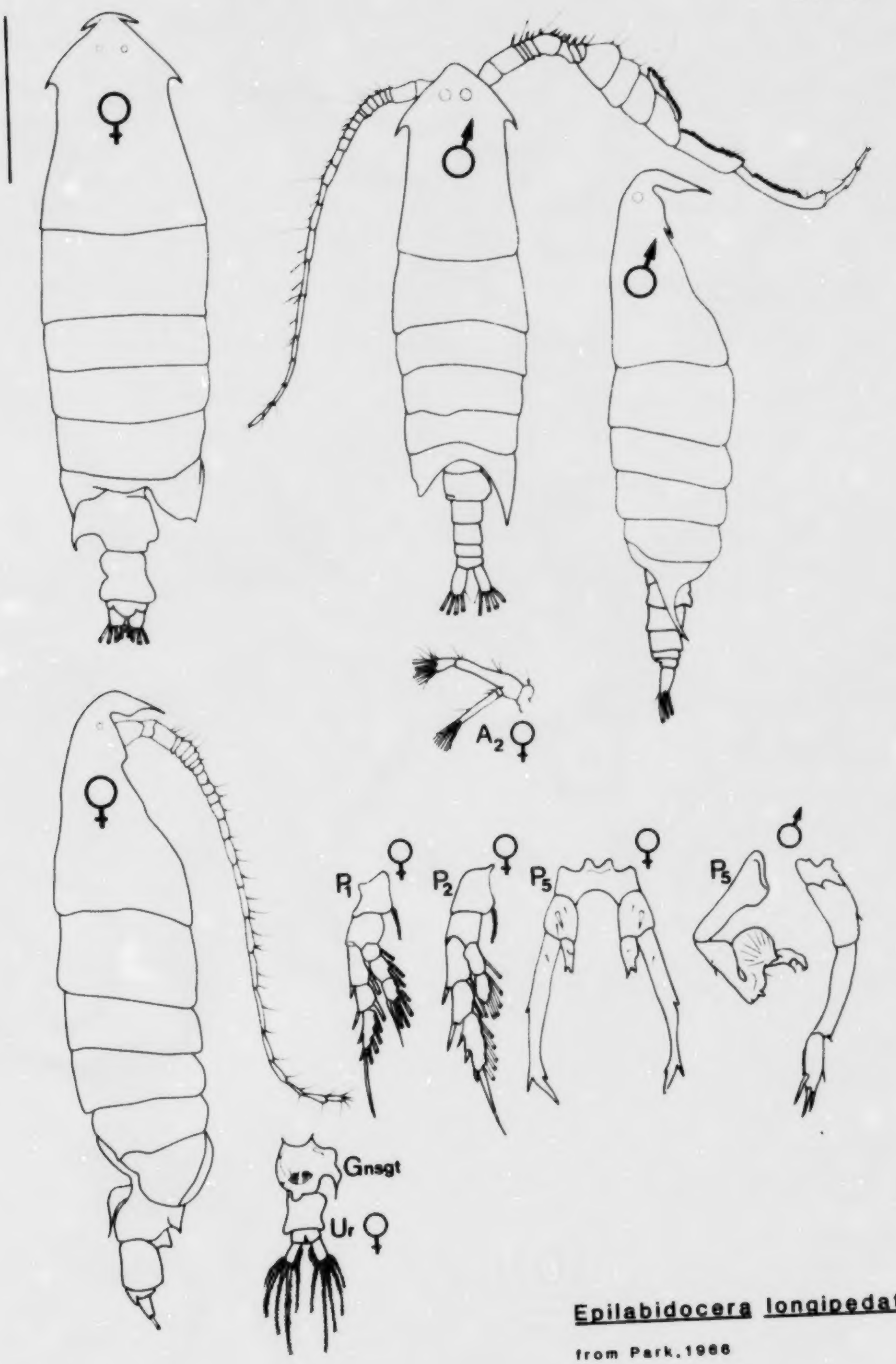
CV	2.73-3.30	NVI	0.54-0.58
CIV	2.23-2.35	NV	0.42-0.50
CIII	1.43-1.50	NIV	0.38-0.41
CII	1.01-1.16	NIII	0.31-0.36
CI	0.76-0.82	NII	0.25-0.27
		NI	0.18-0.19

Comments:

Park (6, 7) has done extensive studies on the internal and external anatomy of this species.

References:

1) Campbell, 1929b
2) Brodsky, 1950
3) Fulton, 1972
4) Cameron, 1957
5) Johnson, 1934a
6) Park, 1965
7) Park, 1966b


♀
♂
♂
A_2 ♀
♀
P_1 ♀
P_2 ♀
P_5 ♀
P_5 ♂
Gnsgt
Ur ♀

Epilabidocera longipedata

from Park,1966

28.1 Acartia Dana, 1846

Morphology:

Body slender, Hd bluntly rounded in dorsal view; PLC rounded; A2 exp shorter than A2 enp1; A2 bp fused with enp1; CR short. P1,2 segmentation: 3-2/3-2; P1 exp1,2 each with long, slender outer distal spine (1).

FEMALE Ur three-segmented; P5 uniramous, three-segmented, 3P5 modified into long, slender spine (1).

MALE Ur five-segmented; rt A1 slightly geniculate. P5 uniramous; rt P5 longer than lft, with three to five segments, rt 2P5 with large inner lobe, lft P5 with two or four segments (1).

The blunt head, short CR and A1, and small size separate this genus from similar local taxa.

References:

1) Bradford, 1976

28.1.1 *Acartia* cf. *clausi* Giesbrecht, 1889

Morphology:

PLC rounded, may be bordered with minute dorsal spines and ventral stiff hairs; Ro absent (1).

FEMALE TL 0.8-1.4 mm; gnsgt and Ur2 with conspicuous spines on dorsal distal margin (1).

MALE TL 0.8-1.2 mm; gnsgt with dorsal hairs along distal margin (1).

Easily separated from other local members of the genus by the absence of a Ro and the PLC without ornamentation.

Distribution and Occurrence:

Verified occurrences only from the North Atlantic and adjacent waters. Locally, reported as *A. clausi* as common in the Strait of Georgia (2, 3, 4) and also from the Queen Charlotte Islands (5). Local identifications may include other *Acartia* species (see comments).

Life History:

Juvenile *Acartia clausi* obtained from the Atlantic Ocean have been well studied. The naupliar stages have been described (6, 7). Copepodites have also been described (6, 7, 8).

Total Length (mm)

fCV	0.79-0.84	NVI	0.28
mCV	0.79-0.93	NV	0.23
fCIV	0.65-0.76	NIV	0.19
mCIV	0.70-0.76	NIII	0.16
CIII	0.51-0.65	NII	0.14
CII	0.42-0.51	NI	0.12
CI	0.25- 0.42		

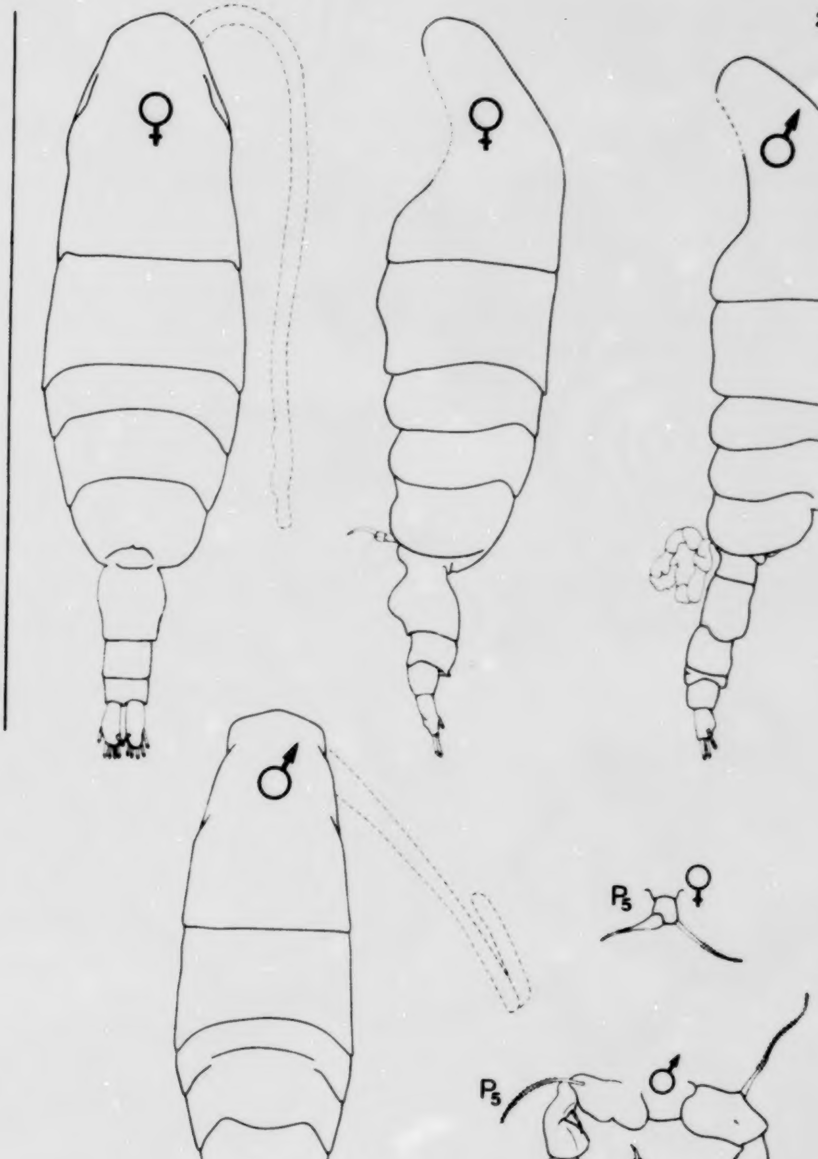
Comments:

The genus *Acartia* is poorly described and in need of revision (1).

References:

1) Bradford, 1976b
2) Campbell, 1929b
3) Legare, 1957
4) Fulton, 1972
5) Cameron, 1957
6) Conover, 1956
7) Ogilvie, 1953 (Fiches, Sheet 50)
8) Conway and Minton, 1975

28.1.1



__*Acartia*__ cf. __*clausi*__

from Bradford, 1976

28.1.2 Acartia danae Giesbrecht, 1889

Morphology:

Ro present, PLC spiniform; distinct spine on 1A1 (1, 2).

FEMALE TL 1.0-1.3 mm; Ur 1, 2 spinulose along dorsal margin; P5 reduced, two-segmented, 2P5 armed with a long, plumose setae; 3P5 elongate, with denticulate distal margin (3).

MALE TL 0.7-0.8 mm; Ur1 with lateral bristles; P5 asymmetrical; 1,2P5 each with a short medial protuberance from the inner margin; rt P5 four-segmented, lft P5 three-segmented (3).

Easily separated from other local species in the genus by the presence of a Ro and spiniform processes on the PLC.

Distribution and Occurrence:

Reported from the Pacific and Atlantic Oceans (1). Locally, reported from the Strait of Juan de Fuca (4).

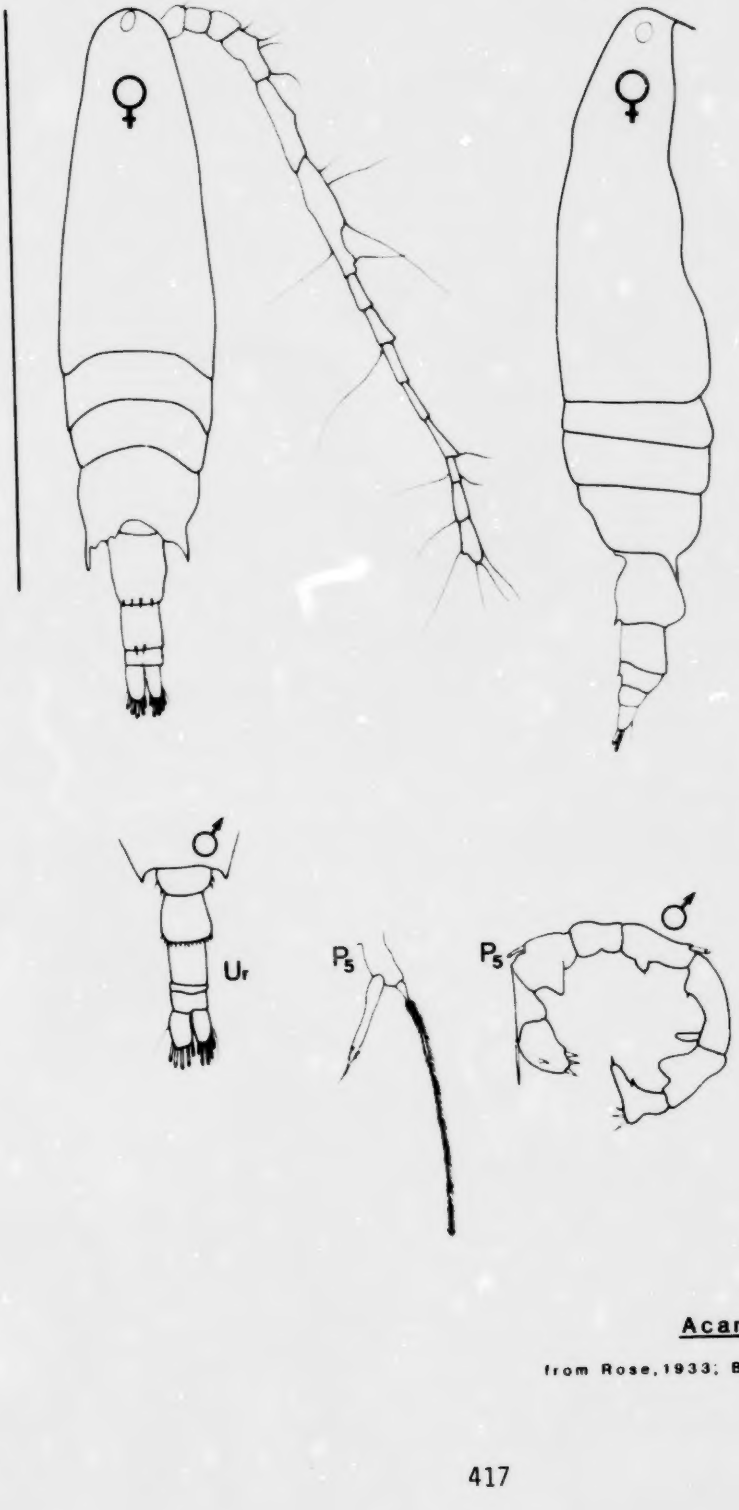
Life History:

Juveniles undescribed, but should be similar in general form to A. clausi (5).

References:

1) Mori, 1937
2) Davis, 1949b
3) Rose, 1933
4) Chester et al., 1980
5) Conover, 1950

28.1.2



Acartia danae

from Rose, 1933; Brodsky, 1962

28.1.3 Acartia longiremis (Lilljeborg, 1853)

Morphology:

Ro absent, PLC each with a long, sharp dorsal spine; ansgt finely spinose (1).

FEMALE TL 1.0-1.3 mm (1).

MALE TL 0.9-1.0 mm; rt 2P5 with spine on inner margin; lft 4P5 broadening distally (1).

Easily separated from other local species of the genus by the absence of a Ro and by the distinct PLC spines; both these features are best seen in lateral view.

Distribution and Occurrence:

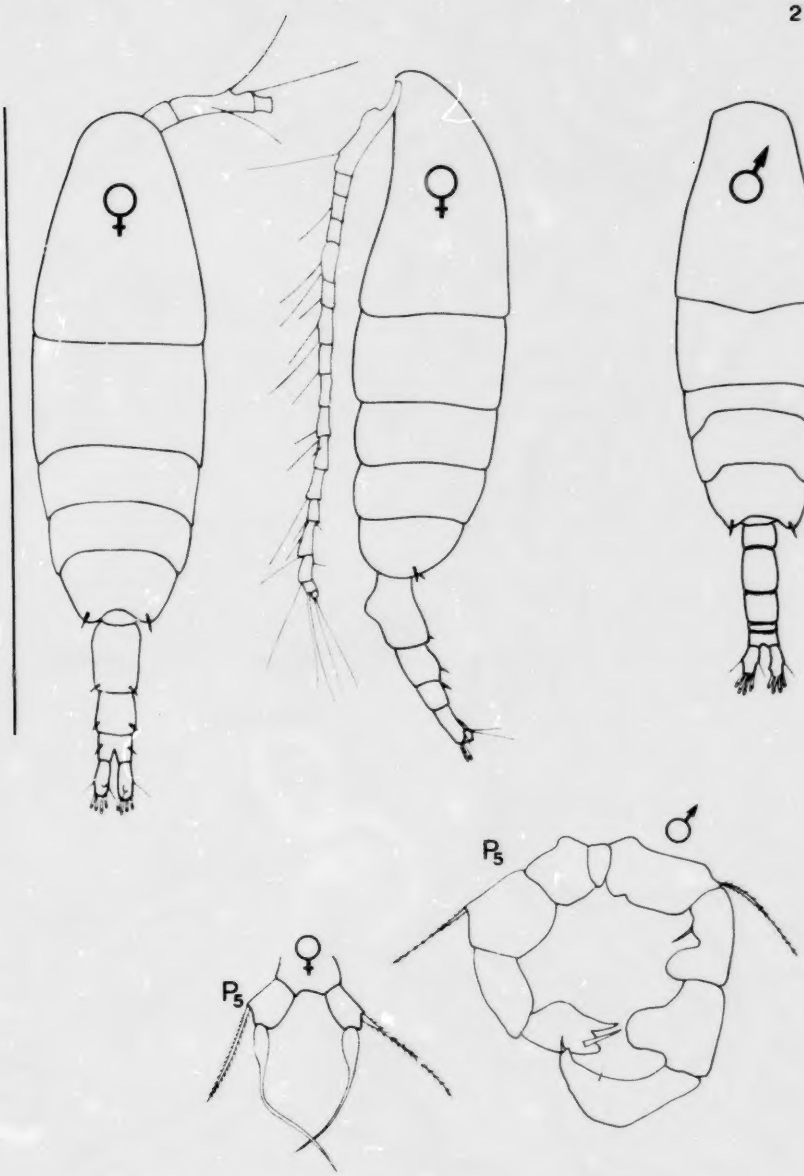
Widespread in the North Atlantic; the Baltic, Black and Bering Seas; and the Seas of Japan and Okhotsk (1). Locally, reported as abundant in the surface waters of the Strait of Georgia (2, 3, 4), the Strait of Juan de Fuca (5) and the Queen Charlotte Islands (6).

Life History:

Juveniles undescribed, but should be similar in general form to those of A. clausi (7).

References:

1) Brodsky, 1950
2) Campbell, 1929b
3) Legare, 1957
4) Fulton, 1972
5) Frolander, 1962
6) Cameron, 1957
7) Conover, 1956



Acartia longiremis

from Sars,1903

28.1.4 Acartia californiensis Trinast, 1976

Morphology:

PLC rounded, with or without spines, Ro present (1).

FEMALE TL 0.96-1.04 mm; Pro:Ur ratio approximately 3.2; Hd slightly vaulted; PLC with or without two small spines on each side; P5 terminal spine with bulbous base, spinules limited to central part, external seta nearly as long as terminal spine (1).

MALE TL 0.87-0.96 mm; Pro:Ur ratio approximately 2.9; PLC with or without one small dorsal spine and several (3-6) more slender, ventral setae on each side; rt 2P5 with bilobed inner protuberance bearing small spine on distal margin, lft 3P5 terminating in long blunt apical spine, slightly flexed, and slender, simple accessory subapical spine (1).

Easily separated from other local members of the genus by the presence of a rostrum and ornamentation of PLC.

Distribution and Occurrence:

Rare in the study area. Reported from the Strait of Georgia near San Juan Island (2).

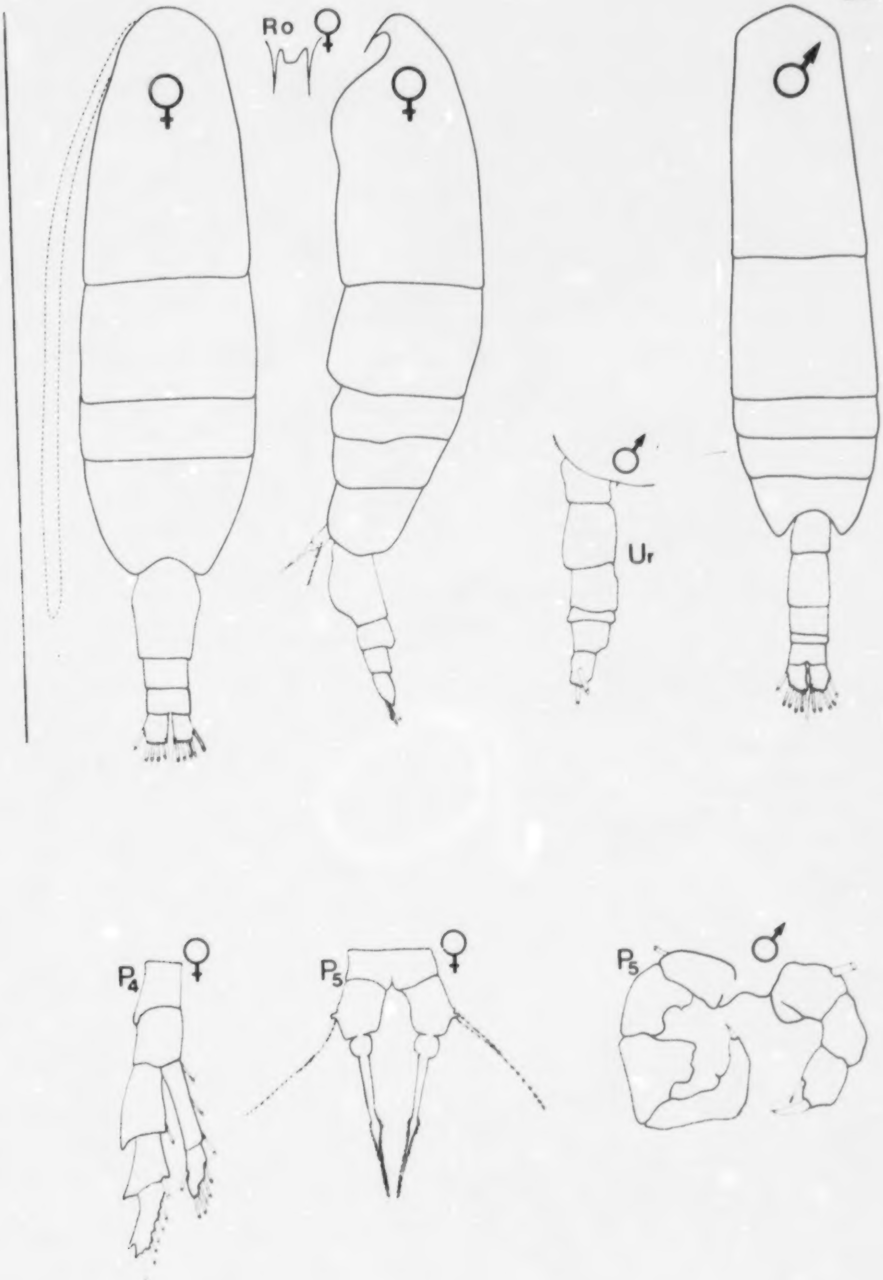
Life History:

Juveniles undescribed, but should be similar in general form to those of A. clausi (3).

References:

1) Trinast, 1976
2) Heron, pers. comm.
3) Conover, 1956

28.1.4


Ro ♀
♀
♀
♂
♂
Ur
P4 ♀
P5 ♀
P5 ♂

Acartia californiensis

from Trinast, 1976

29.1 Tortanus Giesbrecht, 1898

Morphology:

Small copepods with Pro anteriorly widened and lateral constriction in Hd region; PLC with rounded or sharp tips; Ur often asymmetrical; CR elongate, sometimes asymmetrical; Ro absent; A2 rami two-segmented; mxp three-segmented. P1,2 segmentation 3-2 or 3-3/3-2 (1).

FEMALE Ur with two or three segments; P5 uniramous, symmetrical, two to three-segmented (1).

MALE Ur five-segmented; rt A1 geniculate; P5 uniramous, asymmetrical; rt P5 with large chela (1).

	Tortanus	Centropages
f gnsgt with spines	n	y
P5 (m and f)	uniramous	biramous

References:

1) Brodsky, 1950

29.1.1 Tortanus discaudatus (Thompson and Scott, 1897)

Morphology:

Ur elongate; CR long and greatly asymmetrical; Ro absent; PLC produced and blunt (1).

FEMALE TL 1.4-2.3 mm; Ur three-segmented (1).

MALE TL 1.3-2.0 mm (1).

Distribution and Occurrence:

Coastal waters of the southern Chukchi Sea, Bering Strait, Sea of Japan, North Sea and North Atlantic (1). Locally, a common surface-living species reported from the Strait of Georgia (2, 3, 4) and Queen Charlotte Islands area (5).

Life History:

All juvenile stages have been described (6). The naupliar stages are illustrated in the introductory sections of the key (Fig. 4).

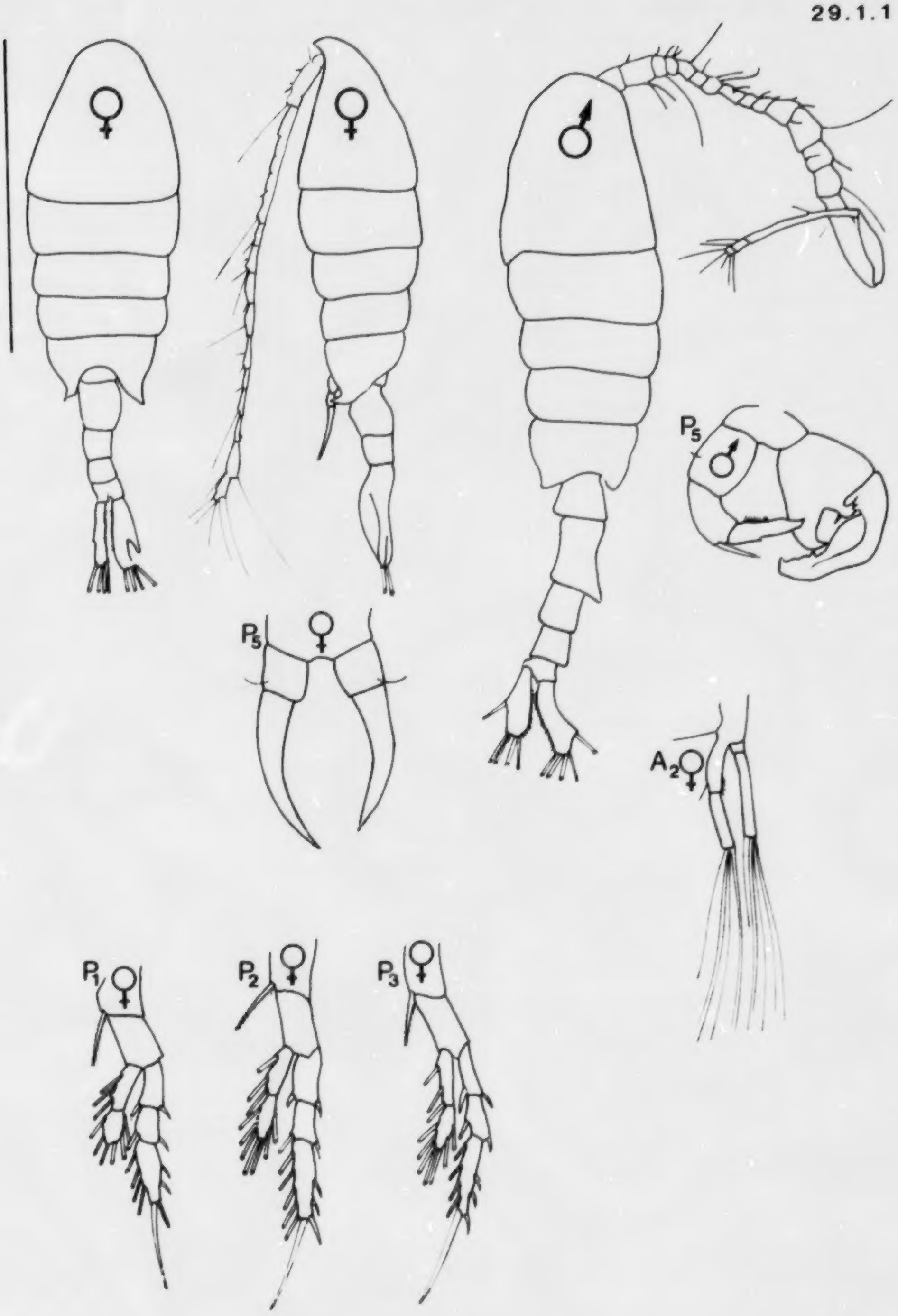
Total Length (mm):

CV	1.2-1.4	NVI	0.4
CIV	1.1	NV	0.3
CIII	1.0	NIV	0.3
CII	0.7	NIII	0.2
CI	0.5	NII	0.1

References:

1) Brodsky, 1950
2) Campbell, 1929b
3) Legare, 1957
4) Fulton, 1972
5) Cameron, 1957
6) Johnson, 1934b

29.1.1


♀
♀
♂
P5 ♂
P5 ♀
A2 ♀
P1 ♀
P2 ♀
P3 ♀

Tortanus discaudatus

from Mori, 1937

8.0 INDEX TO IDENTIFICATION MANUAL

abdominalis (Centropages) 352, **353**
abdominalis (Pleuromamma) 334, **335**
Acartia 413
Aetideus 199
affinis (Eurytemora) 314, **315**
affinis (Scaphocalanus) 282, **283**
americana (Eurytemora) 316, **317**
anglicus (Corycaeus) 98, **99**
antarcticus (Racovitzanus) 296, **297**
arcuicornis (Clausocalanus) 180, **181**
Arietellus 395
Ascomyzon 93
Azygokeras 255

bicornuta (Lucicutia) 356, **357**
bipinnata (Candacia) 404, **405**
bispinosa (Undeuchaeta) 248, **249**
borealis (Oncaea) 114, **115**
borealis (Pleuromamma) 336, **337**
Bradyidius 205, **15**
brevicaudatus (Spinocalanus) 192, **193**
brevicornis (Scaphocalanus) 284, **285**
bungii (Eucalanus) 152, **153**

Calanus 135
californica (Euchaeta) 260, **261**
californicus (Eucalanus) 154, **155**
californiensis (Acartia) 420, **421**
Calocalanus 163
canadensis (Monstrilla) 82, **83**
Candacia 403
catus (Corycaeus) 100, **101**
Centraugaptilus 383
Centropages 351, **14**
Chiridius 211
Chirundina 243
clausi (Acartia) 414, **415**
clausi (Heterorhabdus) 364, **365**
Clausocalanus 179
columbiae (Azygokeras) 256, **257**
columbiae (Candacia) 406, **407**
conifera (Oncaea) 116, **117**
Corycaeus 97
cristatus (Neocalanus) 142, **143**
Ctenocalanus 187
curticauda (Euchirella) 234, **235**
curticauda (Metridia) 322, **323**

danae (Acartia) 416, **417**
dilatata (Pseudolubbockia) 132, **133**
discaudatus (Tortanus) 424, **425**
divergens (Aetideus) 200, **201**

echinatus (Scaphocalanus) 286, **287**
elongata (Euchaeta) 262, **263**
emarginata (Scolecithricella) 300, **301**
englishi (Oncaea) 118, **119**
Epilabidocera 409
Eucalanus 151, **14**
Euchaeta 259, **14**
Euchirella 233
Eurytemora 313

flavicornis (Lucicutia) 358, **359**
frontalis (Lophothrix) 278, **279**
fultoni (Tharybis) 310, **311**

Gaetanus 225
Gaidius 217
Gaussia 347
gracilis (Chiridius) 212, **213**

Haloptilus 387
helgolandica (Monstrilla) 84, **85**
Heterorhabdus 363
Heterostylites 377
horridus (Spinocalanus) 194, **195**
hyalinus (Eucalanus) 156, **157**

integer (Phyllopus) 400, **401**
intermedius (Gaetanus) 226, **227**
ivlevi (Oncaea) 120, **121**

lividus (Clausocalanus) 182, **183**
longicornis (Heterostylites) 378, **379**
longicornis (Spinocalanus) 196, **197**
longipedata (Epilabidocera) 410, **411**
longiremis (Acartia) 418, **419**
longiremis (Monstrilla) 86, **87**
Lophothrix 277
Lubbockia 125
lucens (Metridia) 324, **325**
Lucicutia 355

Macrocheiron 103
magnus (Onchocalanus) 270, **271**
magnus (Scaphocalanus) 288, **289**
major (Heterostylites) 380, **381**
major (Scaphocalanus) 290, **291**
marshallae (Calanus) 136, **137**
media (Euchaeta) 264, **265**
Mesocalanus 147
Metridia 321
Microcalanus 175
Microsetella 75
miles (Gaetanus) 228, **229**
minor (Scolecithricella) 302, **303**
minuta (Lubbockia) 126, **127**
minutus (Gaidius) 218, **219**
minutus (Pseudocalanus) 172, **173**
Monstrilla 81

nasutus (Rhincalanus) 160, **161**
Neocalanus 141
norvegica (Microsetella) 76, **77**

Oithona 107
okhotensis (Metridia) 326, **327**
Oncaea 113
Onchocalanus 269
ovalis (Lucicutia) 360, **361**
ovata (Scolecithricella) 306, **307**
oxycephalus (Haloptilus) 388, **389**

Pachytilus 391
pacifica (Eurytemora) 318, **319**
pacifica (Metridia) 328, **329**
pacificus (Aetideus) 202, **203**
pacificus (Calanus) 138, **139**
pacificus (Pachytilus) 392, **393**
papilliger (Heterorhabdus) 366, **367**
Paracalanus 167
parapergens (Clausocalanus) 184, **185**
parvus (Paracalanus) 168, **169**
persecans (Scottocalanus) 274, **275**
Phyllopus 399
pileatus (Gaetanus) 230, **231**
Pleuromamma 333
plumchrus (Neocalanus) 144, **145**
plumifer (Arietellus) 396, **397**
polaris (Chiridius) 214, **215**
polyspina (Pseudochirella) 252, **253**
porcellus (Centraugaptilus) 384, **385**
princeps (Gaussia) 348, **349**
princeps (Metridia) 330, **331**

prolata (Oncaea) 122, **123**
Pseudocalanus 171
Pseudochirella 251
Pseudolubbockia 131
pseudopulchra (Euchirella) 238, **239**
pulchra (Euchirella) 236, **237**
pungens (Gaidius) 220, **221**
pusillus (Microcalanus) 176, **177**
pygmaeus (Microcalanus) 176, **177**

quadrungulata (Pleuromamma) 338, **339**

Racovitzanus 295
Rhincalanus 159, **14**
robusta (Pleuromamma) 340, **341**
robustoides (Heterohabdus) 368, **369**
robustus (Heterohabdus) 370, **371**
rosea (Microsetella) 78, **79**
rostrata (Euchirella) 240, **241**
rubrum (Ascomyzon) 94, **95**

saanichi (Bradyidius) 206, **207**
sargassi (Macrocheiron) 104, **105**
Scaphocalanus 281
Scolecithricella 299
Scottocalanus 273
scutullata (Pleuromamma) 342, **343**
similis (Bradyidius) 208, **209**
similis (Oithona) 108, **109**
spinifrons (Heterorhabdus) 372, **373**
spinirostris (Oithona) 110, **111**
Spinocalanus 191
spinosa (Euchaeta) 266, **267**
spinosa (Monstrilla) 88, **89**
streetsi (Chirundina) 244, **245**
styliremis (Calocalanus) 164, **165**
subbrevicornis (Scaphocalanus) 292, **293**
subdentata (Scolecithricella) 304, **305**

tanneri (Heterorhabdus) 374, **375**
tenuicornis (Mesocalanus) 148, **149**
Tharybis 309
Tortanus 423, **14**

Undeuchaeta 247
vanus (Ctenocalanus) 188, **189**
variabilis (Gaidus) 222, **223**

wandelli (Monstrilla) 90, **91**
wilsonae (Lubbockia) 128, **129**

xiphias (Pleuromamma) 344, **345**

PART II

ANNOTATED BIBLIOGRAPHY AND ANCILLARY REFERENCES

9.0 INTRODUCTION

This Annotated Bibliography forms the second of two parts on the British Columbia Pelagic Marine Copepoda. An explanation of synonymies is provided in Part I: "British Columbia Pelagic Marine Copepoda: An Identification Manual". The list of pelagic, marine copepods was compiled from the literature on zooplankton distributions in the study area and from samples collected by the Ocean Ecology Laboratory, Institute of Ocean Sciences in that area.

The Bibliography was developed from information available through library sources and the personal literature files of J. D. Fulton, C. C. Davis and G. A. Gardner, and is divided into two sections. The literature reviewed in the first section was selected for its taxonomic value. All references judged to be useful in the identification of juvenile and adult copepods are annotated. All pertinent species are named unless more than ten local species are described, in which case the new species descriptions are identified and the total number of species is noted. References included in the second section deal more with ecological and distributional aspects than with taxonomy. Most of these references refer directly to one or more local species; others contain relevant information on species closely related to local taxa.

If a given author or authors had more than one publication in a single year, letter designations following the year were added for clarification. In some instances, the first letter designated will be found in the Ancillary References and the second in the Annotated section. This is due to later-stage additions of material in which the first reference had already been extensively cited in the Identification Manual. Because citations for some publications listed in Ancillary References were obtained from secondary sources rather than from examination of original works they may occasionally be incomplete.

All references are arranged alphabetically by author. The Annotated Section includes a systematic index to the orders Calanoida, Cyclopoida, Monstrilloida, and Harpacticoida, plus separate entries for naupliar and copepodite stages. Within each Order, the genera and species are arranged alphabetically.

10.0 ANNOTATED BIBLIOGRAPHY

Bernard, M. 1958. Revision des *Calocalanus* (Copepodes, Calanoida). Bull. Soc. Zool. France 83: 185-199.

Geog. Loc.: Bay of Alger, eastern Atlantic.
Local Taxa: *Calocalanus styliremis*.
Annot. Source: Summary of text.

The genus *Calocalanus* is subdivided into three genera (*Calocalanus*, *Leptocalanus*, *Dolichocera*) and it is suggested that this group should comprise a new family, the Calocalanidae. Full family and generic descriptions are given. Two new species (*C. pseudocontractus*, *L. equalicauda*) and males of previously existing species (*C. pavo*, *L. plumulosus*, *D. tenuis*) are described.

Bowman, T.E. 1955. A new copepod of the genus *Calanus* from the northeastern Pacific with notes on *Calanus tenuicornis* Dana. Pac. Sci. 9: 413-421.

Geog. Loc.: California coastline, northeastern Pacific.
Local Taxa: *Mesocalanus tenuicornis*.
Annot. Source: Summary of text.

Samples taken off the California coastline contained two types of specimens with characters agreeing with those given in the literature for *Calanus tenuicornis* Dana. A discussion is given of the taxonomic status of *Calanus tenuicornis* and how the new species, *Calanus lighti*, differs from it.

Bradford, J.M. 1971a. *Aetideus* and *Euaetideus* (Copepoda: Calanoida) from the Atlantic and Pacific Oceans. N.Z.J. Mar. Freshwat. Res. 5(1): 12-40.

Geog. Loc.: Atlantic and Pacific Oceans.
Local Taxa: *Aetideus*.
Annot. Source: Author's abstract.

The genus *Euaetideus* Sars, 1925 is merged with *Aetideus* Brady, 1883 (Copepoda: Calanoida: Aetideidae). Three new species of the genus *Aetideus* (*A. pseudarmatus*, *A. divergens*, *A. truncatus*) are described from the Pacific as well as the males of three other known species (*A. giesbrechti*, *A. acutus*, *A. bradyi*). A key is given to the known males and females in the genus *Aetideus*. The closely related genera *Paivella* and *Snelliaetideus* are compared with *Aetideus*.

Bradford, J.M. 1971b. New and little known species of Heterorhabdidae (Copepoda: Calanoida) from the southwest Pacific. N.Z.J. Mar. Freshwat. Res. 5(1): 120-140.

Geog. Loc.: Southwestern Pacific.
Local Taxa: Heterorhabdidae, *Heterohabdus tanneri*, *H. proximus*.
Annot. Source: Modified author's abstract.

Three new species of calanoid copepods are described. They are *Heterorhabdus spinosus*, *H. lobatus*, and *Disseta magna*. The males *H. pustulifer* and *H. caribbeanensis* are discussed and the identities of *H. proximus*, *H. norvegicus* and *H. austrinus* are clarified. *H. spinifer* is recorded for the second time. A key to the subgenus *Heterorhabdus* is provided.

Bradford, J.M. 1973. Revision of the family and some generic definitions in the Phaennidae and Scolecithricidae (Copepoda: Calanoida). N.Z.J. Mar. Freshwat. Res. 7(1 & 2): 133-152.

Geog. Loc.: Global.
Local Taxa: *Lophothrix*, *Scaphocalanus*, *Scolecithricella*.
Annot. Source: Modified author's abstract.

The families Phaennidae and Scolecithricidae are redefined. The scolecithricid genera *Scolecithrix*, *Scolecithricella*, *Amallothrix*, *Scaphocalanus* and *Lophothrix* are redefined. It is suggested that the species *Scolecithrix ctenopus*, *S. auropecten*, *S. fowleri* and *Amallophora altera* represent four groups of species which probably should be given generic status. A new species of *Parundinella* is named and a juvenile *Neoscolecithrix* is described.

Bradford, J.M. 1976a. A new species of *Bradyidius* (Copepoda, Calanoida) from the Mgazana estuary, Pondoland, South Africa, and a review of the closely related genus *Pseudotharybis*. Ann. S. Afr. Mus. 72(1): 1-10.

Geog. Loc.: Indian Ocean.
Local Taxa: *Bradyidius saanichi*, *B. similis*.
Annot. Source: Summary of text.

A new species, *Bradyidius hirsutus*, is described. The author transfers four species previously attributed to *Bradyidius* to the genus *Pseudotharybis*. A table is given comparing the remaining ten species of *Bradyidius* and summarizing the differences between them.

Bradford, J.M. 1976b. Partial revision of the *Acartia* subgenus (Copepoda: Calanoida: Acartiidae). N.Z.J. Mar. Freshwat. Res. 10(1): 159-202.

Geog. Loc.: Global.
Local Taxa: *Acartia* spp., *Acartia longiremis*.
Annot. Source: Author's abstract.

Specimens of the *Acartia* subgenus *Acartiura* which are closely related to *A. clausi* Giesbrecht, 1889 were examined from European waters, the east and west coasts of the United States, Japan, Australia, and New Zealand. The species *A. ensifera* Brady, 1899 and *A. simplex* Sars, 1905 are redescribed, *A. hudsonica* Pinhey, 1926 is elevated from subspecific to specific status, and five new species (*A. jilletti*, *A. lefevreae*, *A. omorii*, *A. teclae*, and *A. tranteri*) are described. A key is given to all known species of *Acartiura*.

Bradford, J.M. and J.B. Jillett. 1974. A revision of generic definitions in the Calanidae (Copepoda: Calanoida). Crustaceana 27(1): 5-16.

Geog. Loc.: Global.
Local Taxa: *Neocalanus plumchrus*, *N. cristatus*, *Mesocalanus tenuicornis*, *Calanus pacificus*.
Annot. Source: Summary of text.

The family Calanidae is redefined and its species are grouped into redefined existing genera: *Calanoides*, *Calanus*, *Canthocalanus*, *Neocalanus*, *Undinula* and two new genera, *Mesocalanus* and *Cosmocalanus*. A table is given listing the occurrence of characters with systematic significance within species of the family Calanidae. No identification key or species descriptions are included.

Bradford, J. M. and J. B. Jillett. 1980. The marine fauna of New Zealand: pelagic calanoid copepods: Family Aetideidae. Mem. N.Z. Oceanogr. Inst. 86. 102 pp.

Geog. Loc.:	Southwestern Pacific.
Local Taxa:	*Euchirella rostrata*, *E. curticauda*, *Chirundina streetsi*, *Gaetanus miles*, *G. pileatus*, *Gaidius minutus*, *G. pungens*.
Annot. Source:	Modified authors' abstract.

The distribution and taxonomy of aetideid calanoid copepods from the southwestern Pacific in the vicinity of New Zealand is recorded. All genera in the Aetideidae are defined and a list of species provided. Many species are fully described and illustrated.

Brady, G. S. 1878. A monograph of the free and semi-parasitic Copepoda of the British Islands. Vols. I, II, III. Ray Soc. Monogr. 53, 55, 56.

Geog. Loc.:	Northeastern Atlantic.
Local Taxa:	*Corycaeus anglicus*.
Annot. Source:	Summary of text.

This is a three volume series on the marine calanoids, cyclopoids, harpacticoids and monstrilloids obtained from the coast of the British Islands. The discussion of the species is more in the form of taxonomic notes than full descriptions. Each volume has numerous plates.

Brodsky, K. A. 1948. Free living copepod crustaceans (Copepoda) of the Sea of Japan. Bull. Pacif. Sci. Inst. Fish., Vladivostock. 26: 3-130 (in Russian).

Geog. Loc: Sea of Japan, northwestern Pacific.
Local Taxa: Calanus pacificus.
Annot. Source: Summary of text.

A comprehensive account of thirty-nine calanoid, seven cyclopoid and four harpacticoid species is presented. Illustrations are gathered into thirty-two plates.

Brodsky, K.A. 1950. Calanoida of the far eastern seas and polar basin of the U.S.S.R. Dokl. Akad. Nauk SSSR 35: 1 - 442 (Translated from Russian by Israel Program for Scientific Translations, Jerusalem. 1967. Transl. No. TT-67-51200. 440 pp.).

Geog. Loc.: Eastern seas and polar basin of the U.S.S.R.
Local Taxa: Calanoida.
Annot. Source: Summary of text.

Using the systematic organization of Sars (1903) the calanoid copepods found in the eastern seas and polar basin of the U.S.S.R. are described and illustrated. Taxonomic revisions are made and many new species and genera are described. The new taxa are: Aetideus pacificus, Pseudochirella polyspina, Scolecithricella minor var. orientalis, Metridia okhotensis, M. pacificus, Pleuromamma scutullata, Spinocalanus brevicaudatus, Gaidius variabilis, and Heterorhabdus robustoides. Eighty-one species discussed by Brodsky have been reported from British Columbia coastal waters.

Brodsky, K.A. 1959. On the phylogenetic relationship of certain species of *Calanus* (Copepoda) from the northern and southern hemispheres. *Zool. Zhur. 38*: 1537-1553 (Translated from Russian by D. Ward, Scottish Marine Biological Association, Oceanic Laboratory, Edinburgh 1960. 13 pp.).

Geog. Loc.:	Global.
Local Taxa:	*Calanus pacificus*.
Annot. Source:	Modified author's conclusion.

The species *Calanus glacialis*, *C. finmarchicus*, *C. helgolandicus*, *C. pacificus*, *C. australus* and *C. chilensis*, each morphologically distinct, are shown to occupy discrete geographical regions having different ecological backgrounds. *Calanus finmarchicus* is thought to be the super species with the others being diverged recently as a result of penetration into different geographic regions.

Brodsky, K.A. 1962. On the fauna and distribution of copepods (Calanoida) of the surface waters of the northwest part of the Pacific Ocean. Issled. Dalnev. Morei SSSR 8: 91-166 (in Russian).

Geog. Loc.:	Sea of Okhotsk, northwestern Pacific.
Local Taxa:	*Calanus pacificus*, *Neocalanus plumchrus*, *N. cristatus*, *Mesocalanus tenuicornis*, *Eucalanus bungii*, *Mecynocera clausii*, *Clausocalanus arcuicornis*, *Lucicutia flavicornis*, *Haloptilus oxycephalus*, *Candacia bipinnata*, *Acartia danae*.
Annot. Source:	Summary of text.

A list of 95 species of calanoid copepods is given for the eastern coast of the Kuril Islands. Taxonomic notes for 33 species, many of which are illustrated, are presented. Distribution density maps of the eight most common species are discussed.

Brodsky, K.A. 1967a. Formation of swimming limbs in the genus *Calanus* (Copepoda) and latitudinal zonality. Dokl. Akad. Nauk SSSR 176 (6): 1441-1444.

Geog. Loc. Northern hemisphere.
Local Taxa: *Calanus pacificus*.
Annot. Source: Summary of text.

The geographical centre of origin for *Calanus* spp. is concluded by the author to be in the high latitudes of the northern hemisphere. Graphical results of comparative morphological analysis of the structure of the fifth pair of swimming legs of *Calanus* spp. males show an increase in asymmetry of the exopodites from the north to the south pole. The presence of a phylogenetic series is discussed.

Campbell, M.H. 1929a. Some free-swimming copepods of the Vancouver Island region. Trans. Roy. Soc. Can. Ser. 3. 23(5): 303-331.

Geog. Loc.: British Columbia, northeastern Pacific.
Local Taxa: *Candacia columbiae*, *Ascomyzon rubrum*.
Annot. Source: Summary of text.

Twenty-one species of marine calanoids, six species of cyclopoids, and five species of harpacticoid copepods discussed are found in B.C. coastal waters. Many of the species are now known under different names. Three new species are described: *Candacia columbiae*, *Ascomyzon rubrum*, and *Zaus caeruleus*.

Campbell, M.H. 1930. Some free-swimming copepods of the Vancouver Island Region II. Trans. Roy. Soc. Can. Ser. 3. 24 (5): 177-182.

Geog. Loc: Vancouver Island region, northeastern Pacific.
Local Taxa: *Gaetanus intermedius*, *Neocalanus plumchrus*, *Macrocheiron sargassi*.
Annot. Source: Modified author's abstract.

Five species are described; three, *Gaetanus intermedius*, *Eurytemora transversalis*, and *Tigriopus triangulus* are new to science. The male of *Calanus tonsus* Brady is described, and *Macrocheiron sargassi* Sars is described and reported for the first time from the northeastern Pacific Coast.

Campbell, M.H. 1934a. The life history and post embryonic development of the copepods, *Calanus tonsus* Brady and *Euchaeta japonica* Marukawa. J. Biol. Bd. Can. 1: 1-65.

Geog. Loc.: Strait of Georgia, northeastern Pacific.
Local Taxa: *Neocalanus plumchrus*, *Euchaeta elongata*.
Annot. Source: Modified author's abstract.

All six naupliar and six copepodite stages of *Calanus tonsus* Brady and *Euchaeta japonica* Marukawa are described and illustrated. All specimens used in this study were collected from the Strait of Georgia, B.C. Experiments in rearing these two species were not successful.

Carrillo, E.B.G., C.B. Miller, and P.H. Wiebe. 1974. Failure of interbreeding between Atlantic and Pacific populations of the marine calanoid copepod *Acartia clausi* Giesbrecht. Limnol. Oceanogr. 19(3): 452-458.

Geog. Loc.: Northwestern Atlantic, northeastern Pacific.
Local Taxa: *Acartia* cf. *clausi*.
Annot. Source: Author's abstract.

An attempt was made to interbreed populations of *Acartia clausi* from Woods Hole, Massachusetts, and Yaquina Bay, Oregon. Individuals from these populations are morphologically similar, but differ somewhat in size. Cultures from both sources produced many successive generations in the laboratory, but interbreeding with production of viable offspring did not occur. This is evidence that the Atlantic and Pacific populations have diverged in isolation to the level required to be assigned species rank.

Cattley, J.G. 1948. Sex reversal in copepods. Nature 161(4120): 937.

Geog. Loc.: North Sea.
Local Taxa: *Pseudocalanus* sp.
Annot. Source: Summary of text.

Six samples collected in the North Sea between February and June 1947 contained a significant number of *Pseudocalanus minutus* parasitized by *Blastodinium contortum hyalinum* (a parasitic dinoflagellate). This parasite causes castration of the host. The external morphology of infected Stage V male and female copepodites and adult females is unaffected. In adult males, however, typical Stage V fifth swimming legs and a mature female genital segment are present. Copulation was observed between these superficially mature but sterile females and unparasitized adult males.

Chiba, T. 1952. Plankton research of Shimondsen Harbor. I. On the copepod *Eurytemora pacifica* Sato. Bull. Jap. Soc. Sci. Fish. 18(2): 63-66 Fig. 1-10 (in Japanese, German summary).

Geog. Loc.: Shimonoseki Harbour, northwestern Pacific.
Local Taxa: *Eurytemora pacifica*.
Annot. Source: Summary of text.

The male and female of *Eurytemora pacifica* are redescribed and illustrated.

Chiba, T., A. Tsurata, and H. Maeda. 1955. Report on zooplankton samples hauled by larvae-net during the cruise of Bikini-Expedition, with special reference to copepods. J. Shimonoseki Coll. Fish. 5(3): 189-213.

Geol. Loc.: Bikini Atoll, northwestern Pacific.
Local Taxa: *Pleuromamma xiphias*, *Candacia bipinnata*.
Annot. Source: Summary of text.

An investigation of the impact of the hydrogen bomb explosion at Bikini Atoll on the zooplankton of that area was conducted, including illustrated taxonomic notes on eight juvenile copepodites. It is concluded that no species of zooplankton was seriously affected by the fission products.

Conover, R.J. 1956. Oceanography of Long Island Sound, 1952-1954. VI. Biology of *Acartia clausi* and *A. tonsa*. Bull. Bingham Oceanogr. Collec. 15: 156 - 233.

Geog. Loc.: Long Island Sound, northwestern Atlantic.
Local Taxa: *Acartia* cf. *clausi*.
Annot. Source: Author's abstract.

The effects of environment on *Acartia clausi* and *A. tonsa* are studied through a combination of field and laboratory studies. The developmental stages of both species are fully described, and various physiological and ecological data presented.

Corkett, C.J. 1968. Observations sur les stades larvaires de *Pseudocalanus elongatus* Boeck et *Temora longicornis* O.F. Muller. Pelagos 8: 51-57 (English summary).

Geog. Loc.: Dalhousie University, Nova Scotia, Canada.
Local Taxa: *Pseudocalanus*.
Annot. Source: Modified English summary.

The copepodites and first naupliar stage of *Pseudocalanus elongatus* are fully described. The antennules of all copepodite and adult stages of *Temora longicornis* are described.

Corkett, C.J. and I.A. McLaren. 1978. The biology of *Pseudocalanus*. Adv. Mar. Biol. 15: 1-213.

Geog. Loc.: Dalhousie University, Nova Scotia, Canada.
Local Taxa: *Pseudocalanus* cf. *minutus*.
Annot. Source: Summary of text.

The systematics and ecology of *Pseudocalanus* is fully described, and the naupliar and copepodite stages are illustrated.

Crisafi, P. 1963. Les copepodes pelagiques du Detroit de Messine *Pleuromamma abdominalis* (Lubbock) et *Pleuromamma gracilis* (Claus) (Copepoda, Calanoida). Morphologie, developpement, et frequence. Rapp. Proc. Verb. Renuions Comm. Int. Expt. Sci. Mer. Mediterranee, Monaco 17(2): 555-561.

Geog. Loc.: Straits of Messina, Ionian Sea.
Local Taxa: *Pleuromamma abdominalis*.
Annot. Source: Summary of text.

The genus *Pleuromamma* is represented in the Straits of Messina by *P. abdominalis* and *P. gracilis*. The author notes frequency of males, females and copepodite stages as well as illustrating and describing copepodite stages III and V for *P. abdominalis* and copepodite stage V for *P. gracilis*.

Crisafi, P. 1974. Some responses of planktonic organisms to environmental pollution. Rev. Int. Oceanogr. Med. 34: 145-154.

Geog. Loc.: Mediterranean Sea.
Local Taxa: *Acartia*, *Paracalanus*, *Centropages*.
Annot. Source: Summary of text.

Muff-shaped formations were found on the anal segments of several species of marine copepods collected in the northeastern Atlantic. They are thought by the author to be intestinal prolapses triggered by man-produced hydrocarbons or pabulum introduced into the marine environment.

Dahl, F. 1893. *Pleuromamma*, ein Krebs mit Leuchtorgan. Zool. Anz. 16: 104-112.

Geog. Loc.: North Atlantic.
Local Taxa: *Pleuromamma xiphias*, *P. abdominalis*, *P. quadrungulata*, *P. robusta*, *P. borealis*.
Annot. Source: Summary of text.

A key to the identification of six species of *Pleuromamma* is presented. Three species, *P. quadrungulata*, *P. borealis* and *P. robusta* are new to science and are described. No illustrations are included.

Damkaer, D.M. 1975. Calanoid copepods of the genera *Spinocalanus* and *Mimocalanus* from the central Arctic Ocean, with a review of the *Spinocalanidae*. NOAA Tech. Rept. Natl. Mar. Fish. Serv. Circ. 391, Seattle. 88 pp.

Geog. Loc.: Global.
Local Taxa: *Mimocalanus*, *Spinocalanus*, *S. brevicaudatus*.
Annot. Source: Author's abstract, in part.

The systematic position of the Spinocalanidae is reconsidered; all published descriptions and records are discussed. Several critical type specimens and specimens forming the bases of widespread records have been examined and are redescribed. Keys to the genera and all of the species have been prepared, with the goal of enabling an investigator to identify even damaged specimens. Many named species or forms have been placed in synonymy, and two new species (*Spinocalanus terranovae* and *Mimocalanus heronae*) are described. The family is now considered to comprise 32 species, distributed as follows: *Spinocalanus* (19), *Monacilla* (4), *Mimocalanus* (8), and *Teneriforma* (1).

Davis, C.C. 1943. The larval stages of the calanoid copepod *Eurytemora hirundoides* (Nordquist). Chesapeake Biol. Lab. Publ. 58. Solomons Island, Maryland. 52 pp.

Geog. Loc.: Chesapeake Laboratory, Solomons Island, Maryland.
Local Taxa: *Eurytemora affinis*.
Annot. Source: Summary of text.

All the naupliar and copepodite stages of *Eurytemora hirundoides* (Nordquist) are described and illustrated in great detail. The introduction contains a section on the history of the study and culturing of juvenile copepods of all orders from both fresh and saltwater habitats.

Davis, C.C. 1949a. A preliminary revision of the Monstrilloida, with descriptions of two new species. Trans. Amer. Microsc. Soc. 68: 245-255.

Geog. Loc.: Chicken Key, Florida, central and western Atlantic.
Local Taxa: Monstrilla.
Annot. Source: Summary of text.

Based on the description of two new species, Monstrilla reticulata and Monstrilla floridana, the number of genera in the family Monstrillidae of the copepod sub-order Monstrilloida are reduced. The author considers the genera Monstrilla and Monstrillopsis too similar to warrant a distinction. The same applies for the genera Thamaleus and Cymbasoma. The generic names Monstrilla and Thamaleus take precedence. Since there is a tendency towards fusion of the urosome segments, it is suggested that only one genus may be valid in the family Monstrillidae. A dichotomous key of the 35 known species of Monstrilloida is given. No illustrations accompany this key.

Davis, C.C. 1949b. The pelagic Copepoda of the northeastern Pacific Ocean. Univ. Wash. Publ. Biol. 14: 1-118.

Geog. Loc.: Eastern Pacific.
Local Taxa: Calanoida, Cyclopoida, Harpacticoida, Cyclopoida.
Annot. Source: Summary of text.

A list of 91 species of pelagic copepods occurring in the region of the Pacific Ocean from San Francisco Bay to the Aleutian Islands is given. Taxonomic descriptions, synonymy, distribution and remarks are included for all the adult stages.

Esterly, C. O. 1905. The pelagic Copepoda of the San Diego region. Univ. Calif. Publ. Zool. 2 (4): 113-233, Fig. 1-62.

Geog. Loc.: San Diego, California, northeastern Pacific.
Local Taxa: Calanoida, Cyclopoida, *Scolecithricella subdentata*.
Annot. Source: Summary of text.

A total of 64 species of marine copepods found off San Diego are discussed. Giesbrecht's 1892 key to genera plus 60 of his species descriptions are translated and included. Four new species (*Labidocera trispinosa*, *Scolecithrix pacifica*, *S. subdentata*, *Sapphirina lomae*) are described and illustrated. Twenty-seven of the species discussed occur in British Columbia coastal waters.

Esterly, C. O. 1906. Additions to the copepod fauna of the San Diego region. Univ. Calif. Publ. Zool. 3 (5): 53-92, pls. 9-14.

Geog. Loc.: San Diego, California, northeastern Pacific.
Local Taxa: *Euchaeta californica*, *Chirundina streetsi*, *Euchirella curticauda*, *Heterorhabdus longicornis*, *H. spinifrons*.
Annot. Source: Summary of text.

Twenty-seven species of calanoids are discussed, eighteen of which are new to science with *Euchaeta californica* being the only one reported from British Columbia waters. Four other species discussed (*Chirundina streetsi*, *Euchirella curticauda*, *Heterorhabdus longicornis*, *H. spinifrons*) are also known to occur in British Columbia coastal waters.

Esterly, C.O. 1911. Third report on the Copepoda of San Diego region. Univ. Calif. Publ. Zool. 6(14): 313-352, pls. 26-32.

Geog. Loc.: San Diego, California.
Local Taxa: *Euchirella rostrata*, *Gaidius pungens*, *Phyllopus interger*, *Undeuchaeta bispinosa*.
Annot. Source: Summary of text.

Twenty-eight species of calanoids are described and illustrated. *Phyllopus integer*, *Undeuchaeta bispinosa*, and twenty other species are described for the first time.

Esterly, C.O. 1913. Fourth taxonomic report on the Copepoda of the San Diego region. Univ. Calif. Publ. Zool. 11(10): 181-196, pls. 10-12.

Geog. Loc.: San Diego, California.
Local Taxa: *Euchaeta elongata*.
Annot. Source: Summary of text.

Brief descriptions and figures are given for 12 new species of calanoid copepods. They are *Arietellus pacificus*, *Augaptilus californicus*, *A. depressus*, *A. romanus*, *A. simplex*, *Euchaeta elongata*, *Gaetanus ascendens*, *Scolecithrix aculeata*, *S. elephas*, *S. longirostris*, *S. mollis*, and *S. obscura*.

Esterly, C.O. 1924. The free-swimming Copepoda of San Francisco Bay. Univ. Calif. Publ. Zool. 26(5): 81-129.

Geog. Loc.: San Francisco, California.
Local Taxa: *Paracalanus parvus*, *Clausocalanus arcuicornis*, *Ctenocalanus vanus*, *Eurytemora affinis*, *Lucicutia flavicornis*, *Epilabidocera longipedata*, *Acartia clausi*.
Annot. Source: Summary of text.

Part I contains species and genera descriptions of eleven pelagic calanoids collected by the "Albatross" in San Francisco Bay. Part II discusses the vertical and geographical distribution and occurrence of the calanoids.

Evans, M.S. 1973. The distributional ecology of calanoid copepod *Pareuchaeta elongata* Esterly. Ph.D. Thesis, University of British Columbia, Vancouver. x + 112 pp.

Geog. Loc.: Straits of Georgia and Juan de Fuca, northeastern Pacific.
Local Taxa: *Neocalanus plumchrus*, *Euchaeta elongata*.
Annot. Source: Summary of text.

This doctoral thesis investigated whether or not, within the geographic range of an organism, variations in water quality are an important environmental variable in determining species abundance. The data showed that differences in abundance could be better explained by differences in primary production and in the origin and residence time of the water. Although seawaters within the study area may vary in quality, these variations probably do not significantly affect species abundance and distribution.

Faber, D.J. 1966. Free-swimming copepod nauplii of Narragansett Bay with a key to their identification. J. Fish. Res. Bd. Can. 23 (2): 189-205.

Geog. Loc.: Narragansett Bay, R.I., northwestern Atlantic.
Local Taxa: *Pseudocalanus*, *Eurytemora affinis*, *E. americana*, *Acartia*, *Tortanus discaudatus*.
Annot. Source: Author's abstract.

Zooplankton surface samples were taken with a No. 12 silk bolting cloth net towed by a Clark-Bumpus quantitative plankton sampler in Narragansett Bay for 12 months. Ten calanoid, three cyclopoid, and one harpacticoid species of free-swimming copepod nauplii were collected. The structure and arrangement of elements of the caudal armatures of these copepod nauplii were used to formulate the illustrated key included in this paper.

Farran, G.P. 1908. Notes on the copepod genus *Oithona*. Ann. Mag. Nat. Hist. Ser. 8. 2: 498-503.

Geog. Loc.: North Atlantic.
Local Taxa: *Oithona plumifera*, *Oithona spinirostris*.
Annot. Source: Summary of text.

Oithona spinirostris and *Scibella sciba* are found to be junior synonyms of *Oithona plumifera*. The possibility of *Oithona challengeri* being a synonym of *Oithona setigera* is suggested. Two new species, *Oithona atlantica* and *Oithona pelagica* are described.

Fiches D'identification du Zooplancton. Cons. Perm. Intern. Explor. Mer. Eds. P. Jespersen and F.S. Russell. (Series of zooplankton publications from 1939 to present).

Geog. Loc.:	Northeastern Atlantic.
Local Taxa:	Calanoida, Cyclopoida, Monstrilloida.
Annot. Source:	Summary of editors' note.

Since 1939, the International Council for the Exploration of the Sea has published a series of zooplankton sheets. These short illustrated leaflets are not intended to be used as a short cut to the identification of northeastern Atlantic zooplankton but as guides to the current taxonomic position of each family with references to the best literature for their identification.

The list of these publications is as follows:

Farran, G.P. 1948a. Copepoda. Sub-order Calanoida; Family Centropagidae; Genus *Centropages*. Sheet 11: 4 pp.

________. 1948b. Copepoda. Sub-order Calanoida; Family Acartiidae; Genus *Acartia*. Sheet 12: 4 pp.

________. 1948c. Copepoda. Sub-order Calanoida; Family Candaciidae; Genus *Candacia*. Sheet 13: 4 pp.

________. 1948d. Copepoda. Sub-order Calanoida; Family Metridiidae; Genus *Metridia*. Sheet 14: 4 pp.

________. 1948e. Copepoda. Sub-order Calanoida; Family Heterorhabdidae; Genera *Heterostylites*, *Hemirhabdus*, *Mesorhabdus*, *Disseta*. Sheet 15: 4 pp.

________. 1948f. Copepoda. Sub-order Calanoida; Family Heterorhabdidae; Genus *Heterorhabdus*. Sheet 16: 4 pp.

________. 1948g. Copepoda. Sub-order Calanoida; Family Metridiidae; Genus *Pleuromamma*. Sheet 17: 4 pp.

Farran, G.P. and W. Vervoort. 1951a. Copepoda. Sub-order Calanoida; Family Calanidae. Sheet 32: 4 pp.

________. 1951b. Copepoda. Sub-order Calanoida; Family Megacalanidae. Sheet 33: 4 pp.

________. 1951c. Copepoda. Sub-order Calanoida; Family Eucalanidae. Sheet 34: 4 pp.

________. 1951d. Copepoda. Sub-order Calanoida; Family Paracalanidae; Genus *Paracalanus*. Sheet 35: 4 pp.

________. 1951e. Copepoda. Sub-order Calanoida; Family Pseudocalanidae; Genera *Pseudocalanus*, *Microcalanus*. Sheet 37: 4 pp.

________. 1951f. Copepoda. Sub-order Calanoida; Family Pseudocalanidae; Genera *Clausocalanus*, *Drepanopus*, *Drepanopsis*, *Ctenocalanus*. Sheet 38: 4 pp.

________. 1951g. Copepoda. Sub-order Calanoida; Family Spinocalanidae; Genus *Spinocalanus*. Sheet 39: 4 pp.

________. 1951h. Copepoda. Sub-order Calanoida; Family Spinocalanidae; Genera *Mimocalanus*, *Monacilla*. Sheet 40: 3 pp.

Vervoort, W. 1952a. Copepoda. Sub-order Calanoida; Family Aetideidae. Key to the genera and references. Sheet 41: 4 pp.

________. 1952b. Copepoda. Sub-order Calanoida: Family Aetideidae; Genera *Aetideus*, *Euaetideus*, *Aetideopsis*. Sheet 42: 4 pp.

________. 1952c. Copepoda. Sub-order Calanoida; Family Aetideidae; Genera *Bradyidius*, *Bradyetes*, *Bryaxis*. Sheet 43: 4 pp.

________. 1952d. Copepoda. Sub-order Calanoida; Family Aetideidae; Genera *Chiridius*, *Pseudoaetideus*, *Chiridiella*. Sheet 44: 4 pp.

________. 1952e. Copepoda. Sub-order Calanoida; Family Aetideidae; Genus *Gaidius*. Sheet 45: 4 pp.

________. 1952f. Copepoda. Sub-order Calanoida; Family Aetideidae; Genus *Gaetanus*. Sheet 46: 5 pp.

________. 1952g. Copepoda. Sub-order Calanoida; Family Aetideidae; Genus *Euchirella*. Sheet 47: 6 pp.

________. 1952h. Copepoda. Sub-order Calanoida; Family Aetideidae; Genus *Pseudochirella*. Sheet 48: 4 pp.

________. 1952i. Copepoda. Sub-order Calanoida; Family Aetideidae; Genera *Chirundina*, *Undeuchaeta*, *Pseudeuchaeta*. Sheet 49: 4 pp.

Ogilvie, H.S. 1953. Copepod nauplii (I). Sheet 50: 4 pp.

Lovegrove, T. 1956. Copepoda nauplii (II). Sheet 63: 4 pp.

Wells, J.B.J. 1970. Copepoda. I. Sub-order Harpacticoida. Sheet 133: 7 pp.

Corral, J. 1972. Copepoda. Sub-order Calanoida; Family Calocalanidae (Paracalanidae part.); Genera *Calocalanus*, *Ischnocalanus*, *Mecynocera*. Sheet 138: 7 pp.

Isaac, M.J. 1975. Copepoda. Sub-order Monstrilloida. Sheet 144/145: 10 pp.

Fleminger, A. 1957. New genus and two new species of Tharybidae (Copepoda, Calanoida) from the Gulf of Mexico with remarks on the status of the family. Fishery Bull. Fish Wildl. Serv. U.S. 116: 347-354.

Geog. Loc.: Gulf of Mexico.
Local Taxa: *Tharybis*.
Annot. Source: Summary of text.

The systematic status of the calanoid family Tharybidae is discussed and a new genus, *Parundinella* is created. A synoptic key to the three genera (*Tharybis*, *Undinella*, *Parundinella*) in the family Tharybidae is presented and two species are described: *Parundinella spinodenticula* and *P. manicula*.

Fleminger A. 1973. Pattern, number, variability, and taxonomic significance of integumental organs (sensilla and glandular pores) in the genus *Eucalanus* (Copepoda, Calanoida). Fishery Bull. 71(4): 965-1010.

Geog. Loc.: Global.
Local Taxa: *Eucalanus attenuatus*, *E. bungii*, *E. californicus*.
Annot. Source: Modified author's abstract.

Methods for the study of bilaterally symmetrical, serially homologous sets of integumental organs comprising hair, peg, and pit sensilla and the pores of integumental glands as well as their number and distribution in the genus are described. Included is a provisional list of valid species and phylogenetic groupings in the genus *Eucalanus* with biogeographic assignment for each species based on records confirmed by the author.

Fontaine, M. 1967. Two new species of *Euchaeta* (Copepoda, Calanoida). Crustaceana 12: 193-213.

Geog. Loc.: Global.
Local Taxa: *Euchaeta*.
Annot. Source: Summary of text.

The species *Euchaeta tonsa* was previously thought to have a cosmopolitan distribution. Closer examination of the literature and of specimens collected from a wide range of locations has identified two new species which are described in this paper. The geographic range of these three species is thought by the author to be as follows: *Euchaeta tonsa* being confined to the North Pacific; *Euchaeta pseudotonsa* n. sp. occurring only in the Atlantic Ocean; *Euchaeta scaphula* being found in the Indian Ocean and the East Indian Archipelago, as well as off Japan and in Monterey Bay, California. Some notes on the systematic status of the genus are included.

Frolander, H.F. 1962. Quantitative estimates of temporal variations of zooplankton off the coast of Washington and British Columbia. J. Fish. Res. Bd. Can. 19 (4): 657-675.

Geog. Loc.: British Columbia and Washington coastline.
Local Taxa: *Oithona spinirostris*, *O. plumifera*, *O. helgolandica*.
Annot. Source: Modified author's abstract.

Quantitative sampling off the coast of Washington and British Columbia shows a regular seasonal variation of zooplankton volumes. Average volumes for the upper 100 meters of water varied from a winter mimimum of 0.035 cc/m^3 in December 1956 to a maximum of 0.139 cc/m^3 in May 1957. The most numerous zooplankters were *Pseudocalanus minutus* (Kroyer) and *Oithona similis* Claus. The paper includes a brief discussion of taxonomic characters used to differentiate *Oithona spinirostris* from *O. plumifera*.

Frost, B.W. 1971. Taxonomic status of *Calanus finmarchicus* and *Calanus glacialis* (Copepoda), with special reference to adult males. J. Fish. Res. Bd. Can. 28: 23-30.

Geog. Loc.: North Atlantic and Arctic.
Local Taxa: *Calanus marshallae*.
Annot. Source: Author's abstract.

A morphometric analysis using certain taxonomic characters of adult males of *Calanus finmarchicus* (Gunnerus) and *C. glacialis* Jaschnov shows that the taxa comprise two non-overlapping clusters. *Calanus finmarchicus* and *C. glacialis* are probably reproductively isolated. Differences between the species in geographical distribution, vertical distribution, and timing of life cycles also support this conclusion. Previous taxonomic studies of adult females of the two species have yielded inconclusive results, probably because the analyses were based largely on subgeneric characters.

Frost, B.W. 1974. *Calanus marshallae*, a new species of calanoid copepod closely allied to the sibling species *Calanus finmarchicus* and *Calanus glacialis*. Mar. Biol. 26: 77-99.

Geog. Loc.: Polar and boreal waters of the northern hemisphere.
Local Taxa: *Calanus marshallae*.
Annot. Source: Summary of text.

Close scrutiny of head, appendage, and genital segment shapes coupled with prosome lengths has identified a new species, *Calanus marshallae* in the *Calanus finmarchicus* species complex.

Frost, B. W. and A. Fleminger. 1968. A revision of the genus *Clausocalanus* (Copepoda: Calanoida) with remarks on distributional patterns of diagnostic characters. Bull. Scripps Inst. Oceanogr. Vol. 12. Univ. Calif. Press, Berkeley. 99 pp., 133 pls.

Geog. Loc.: Global.
Local Taxa: *Clausocalanus arcuicornis*, *C. lividus*, *C. parapergens*.
Annot. Source: Summary of text.

The genus *Clausocalanus* consists of small, holoplanktonic species of marine calanoid copepods. The principle difference between species is the formation of primary and secondary structures. All but two of the 13 species in this genus have a circumpolar distribution and many species co-occur. The paper includes a key to species, distribution patterns, species descriptions and illustrations as well as a discussion on patterns of morphological divergence.

Fulton, J. D. 1972. Keys and references to the marine Copepoda of British Columbia. Fish. Res. Bd. Can. Tech. Rept. 313. 63 pp.

Geog. Loc.: Strait of Georgia, northeastern Pacific.
Local Taxa: Calanoida, Cyclopoida.
Annot. Source: Summary of text.

A key to adult female copepods is based on total body length and shape for 46 species of calanoids and 4 species of cyclopoids. Tables are included which differentiate some naupliar and copepodite stages. No taxonomic descriptions are included. Under each entry in the species list is a list of references.

Gallien, L. 1934. Description du male de *Monstrilla helgolandica* Claus. Synonymie de *Monstrilla serricornis* G.O. Sars et de *Monstrilla helgolandica* Claus. Bull. Soc. Zool. Fr. 59: 377-382.

Geog. Loc.: France, northeastern Atlantic.
Local Taxa: *Monstrilla helgolandica*.
Annot. Source: Summary of text.

While observing a parasitic gastropod (*Odostromia tissoides*), on mussels, eight female specimens of *Monstrilla helgolandica* Claus and three previously unknown males of the same species were obtained. Both sexes of *M. serricornis* Sars, of which only the males are known, are thought to be synonymous with the newly described *M. helgolandica* male. The species *M. serricornis* therefore is regarded as a synonym of *M. helgolandica*.

Gibbons, S.G. 1936. Early development stages of Copepoda. I. *Rhincalanus nasutus* and *Eucalanus elongatus*. Ann. Mag. Nat. Hist. Ser. 10. 18: 384-392.

Geog. Loc: Atlantic Ocean north of Scotland.
Local Taxa: *Rhincalanus nasutus*, *Eucalanus elongatus*.
Annot. Source: Summary of text.

Nauplii from a sample taken in May 1929 at 59° 17' N, 6° 53' W were identified as *Rhincalanus nasutus* and *Eucalanus elongatus*. Both of these species emerge from the egg as Stage II nauplii. Since *Rhincalanus nasutus* nauplii had previously been described by Gurney (1934), only the discrepancies were noted. A complete description of stage II to stage VI *Eucalanus elongatus* naupii is contained in the paper. Some illustrations are included.

Gibbons, S.G. 1937. Early development stages of Copepoda. II. *Metridia lucens* Boeck. Ann. Mag. Nat. Hist. Ser. II. 2: 493-497.

Geog. Loc.: North Sea.
Local Taxa: *Metridia lucens*, *Calanus*.
Annot. Source: Summary of text.

The first two naupliar stages of the Atlantic species *Calanus finmarchicus* and *Metridia lucens* are virtually indistinguishable from each other. Nauplii III to V differ in the thickness and texture of the caudal spines. Nauplius VI of *Metridia lucens* was not located.

Gibbons, S.G., and H.S. Ogilvie. 1933. Developmental stages of *Oithona helgolandica* and *O. spinirostris* with a note on the occurrence of body spines in cyclopoid nauplii. J. Mar. Biol. Ass. U.K. 18: 529-550.

Geog. Loc.: North Sea and northeastern Atlantic.
Local Taxa: *Oithona similis*, *O. spinirostris*.
Annot. Source: Summary of text.

Oithona helgolandica is redescribed; *O. similis* is confirmed as a synonym. The occurrence of body spines on cyclopoid nauplii is discussed. Naupliar and copepodite stages of *O. helgolandica* and *O. spinirostris* are described.

Gibson, V.R., and G.O. Grice. 1977. The developmental stages of *Labidocera aestiva* Wheeler 1900 (Copepoda, Calanoida). Crustaceana 32(1): 7-20.

Geog. Loc.:	Vineyard Sound, northwestern Atlantic.
Local Taxa:	*Epilabidocera*.
Annot. Source:	Extracted from the text.

The post-embryonic development of *Labidocera aestiva* is described based on specimens reared in the laboratory. Sexual dimorphism first becomes apparent in the structure of the fifth swimming leg of copepodite IV.

Giesbrecht, W. 1895. Reports on the dredging operations off the west coast of Central America to the Galapagos, to the west coast of Mexico and in the Gulf of California, carried out by the U.S. Fish Commission Steamer Albatross during 1891. Part XVI: die pelagischen copepoden. Bull. Mus. Comp. Zool. Harv. 25: 243-263, 4 pls. (in German).

Geog. Loc.:	Central eastern Pacific.
Local Taxa:	*Chirundina streetsi*, *Gaidius pungens*, *Scottocalanus persecans*, *Lophothrix frontalis*, *Heterorhabdus tanneri*.
Annot. Source:	Summary of text.

An annotated species list of calanoid and cyclopoid copepods collected in the Central eastern Pacific by the Albatross in 1891 is given. Three new genera (*Gaidius*, *Chirundina*, *Lophothrix*) and ten new species are described.

Grainger, E.H. 1964. Zooplankton from the Arctic Ocean and adjacent Canadian waters. J. Fish. Res. Bd. Can. 22(2): 543-564.

Geog. Loc.: Canadian Arctic.
Local Taxa: *Microcalanus pygmaeus*, *Calanus*.
Annot. Source: Summary of text.

Zooplankton collections from the Arctic Ocean, the Beaufort Sea, and northwestern Canadian coastal waters are described, along with physical characteristics of the water samples. The 50 species identified can be subdivided into three groups: the surface waters of the Arctic Ocean, the deep layer of the surface waters of the Arctic Ocean, and the waters of the Atlantic Ocean. Development rates of two copepods, *Microcalanus pygmaeus* and *Calanus glacialis*, are discussed.

Grice, G.D. 1962. Calanoid copepods from equatorial waters of the Pacific Ocean. Fishery Bull. Fish Wildl. Serv. U. S. 61: 171-246.

Geog. Loc.: Central Pacific.
Local Taxa: Calanoida.
Annot. Source: Summary of text.

One hundred ten species of calanoid copepods collected in the central Pacific are discussed. Twenty-one of these are known to occur in British Columbia coastal waters. References to distribution, ecology, and diagnostic characters such as total body length are presented. Many species are illustrated.

Grice, G.D. 1963a. Deep water copepods from the western north Atlantic with notes on five species. Bull. Mar. Sci. Gulf Caribb. 13(4): 393-501.

Geog. Loc.: Northwestern Atlantic.
Local Taxa: *Lucicutia ovalis*.
Annot. Source: Modified author's abstract.

A list of 138 species of Copepoda from 15 deep plankton samples taken between 41°N and 15°N in the Atlantic Ocean is presented. The distribution of *Calanus finmarchicus* Gunnerus, *C. helgolandicus* (Claus), and *Haloptilus longicirrus* Brodsky are discussed. *Isochaeta ovalis* Giesbrecht and *Lucicutia frigida* Wolfenden are declared synonymous. *Lucicutia ovalis* Wolfenden has been renamed *Lucicutia gaussae*, nom. nov. because of homonymy.

Grice, G.D. 1971. The developmental stages of *Eurytemora americana* Williams, 1906 and *Eurytemora herdmani* Thompson and Scott (Copepoda:Calanoida). Crustaceana 20: 145-158.

Geog. Loc.: Woods Hole, northeastern Atlantic.
Local Taxa: *Eurytemora americana*.
Annot. Source: Summary of text.

Eurytemora americana and *Eurytemora herdmani* were reared through all life history stages from eggs collected at Woods Hole. All stages are briefly described and well figured.

Herdman, W.A., I.C. Thompson, and A. Scott. 1898. On the plankton collected continuously during two traverses of the North Atlantic in the summer of 1897; with descriptions of new species of Copepoda; and an appendix on dredging in Puget Sound. Trans. Liv. Biol. Soc. 12: 33-83, pls. V-VII.

Geog. Loc.: North Atlantic, Puget Sound, northeastern Pacific.
Local Taxa: *Tortanus discaudatus*.
Annot. Source: Summary of text.

Zooplankton observations made during two Atlantic crossings in 1897 include various species lists stating dates, times, and positions of collections. Distributional notes on copepods are discussed, with descriptions of three new calanoids (*Corynura discaudata*, *Acartia forcipata*, *Eurytemora herdmani*), and one new cyclopoid (*Pseudolichomolgus columbiae*). A species list of plankton and dredged invertebrates is given in the appendix.

Heron, G.A. 1964. Seven species of *Eurytemora* (Copepoda) from northwestern North America. Crustaceana 7(3): 199-211.

Geog. Loc.: Northwestern Alaskan coast.
Local Taxa: *Eurytemora americana*, *E. pacifica*.
Annot. Source: Summary of text.

Seven species of *Eurytemora* (Copepoda: Calanoida) were collected close to the northwestern Alaskan coast during August 1959. Various body measurements were made along with notes on the external morphology of the specimens. Many illustrations are included.

Heron, G.A. 1977. Twenty-six species of Oncaeidae (Copepoda: Cyclopoida) from the southwest Pacific - Antarctic area. Biology of the Antarctic Seas. VI: Antarctic Res. Ser. 26: 37-96.

Geog. Loc.: Antarctic waters.
Local Taxa: Oncaea englishi, O. prolata.
Annot. Source: Author's abstract.

Adult Oncaeidae found in five samples collected during a cruise of the V.S.N.S. Eltanin in the sub-Antarctic and Antarctic zones of the southwestern Pacific Ocean are listed including descriptions of 18 new species and 3 established species of Oncaea, two new species and one established species of Conaea, and two new species placed in a new genus, Epicalymma.

Heron, G.A. and D.M. Damkaer. 1969. Five species of deep-water cyclopoid copepods from the plankton of the Gulf of Alaska. Smith. Contr. Zool. 20: 1-24.

Geog. Loc.: Gulf of Alaska, northeastern Pacific.
Local Taxa: Lubbockia wilsonae, Pseudolubbockia dilatata.
Annot. Source: Author's abstract.

Five species of Cyclopoida found in samples collected from 340 to 1275 meters in the Gulf of Alaska are considered. Lubbockia wilsonae, a new species, is described. Other descriptions are given for Lubbockia glacialis, Pseudolubbockia dilatata, Ratania atlantica and Pontoeciella abyssicola.

Heron, G.A., and D.M. Damkaer. 1978. Seven *Lubbockia* species (Copepoda: Cyclopoida) from the plankton of the northeast Pacific, with a review of the genus. Smith. Contr. Zool. 267. 36 pp.

Geog. Loc.: Northeastern Pacific.
Local Taxa: *Lubbockia minuta*, *L. wilsonae*.
Annot. Source: Summary of text.

The family Oncaeidae and the genus *Lubbockia* are described, including descriptions of five new species: *Lubbockia carinata*, *L. forcipula*, *L. flemingi*, *L. petersoni*, and *Lubbockia* sp. Only fifth stage copepodites were obtained for *Lubbockia* sp. so a specific epithet was deferred. Five other species of *Lubbockia* are described and illustrated.

Hulsemann, K. 1966. A revision of the genus *Lucicutia* (Copepoda: Calanoida) with a key to its species. Bull. Mar. Sci. Miami 16(4): 702-747.

Geog. Loc.: Global.
Local Taxa: *Lucicutia flavicornis*, *L. bicornuta*.
Annot. Source: Author's abstract.

The genus *Lucicutia* is revised. Thirty-seven species within the genus are recognized and presented in a list with notes on synonymies and distribution. Six new species are diagnosed and additional descriptions given for certain other species. A key for the identification of the species of *Lucicutia* is included.

Humes, A.G., and J.H. Stock. 1973. A revision of the family Lichomolgidae Kossman, 1877. Cyclopoid copepods mainly associated with marine invertebrates. Smith. Contr. Zool. 127. 368 pp.

Geog. Loc.: Global.
Local Taxa: Macrocheiron sargassi.
Annot. Source: Summary of text.

A revision of the cyclopoid family Lichomolgidae and its associated genera is contained in this paper. Key to genera and species are included. All species are fully described and illustrated.

Isaac, M.J. 1974. Copepoda Monstrilloida from southwest Britain including six new species. J. Mar. Biol. Ass. U.K. 54: 127-140.

Geog. Loc.: Bristol Channel and Irish Sea, northeastern Atlantic.
Local Taxa: Monstrilla.
Annot. Source: Modified author's abstract.

The family Monstrillidae is here divided into three genera, Monstrilla Dana, Thaumaleus Kroyer and Monstrillopsis Sars. Fifteen species of monstrillid copepods are listed for the Bristol Channel and Irish Sea, of which six are new and are described here for the first time. There is some evidence that the pelagic stage of monstrillids may aggregate.

Jillett, J.B. 1968. *Calanus tonsus* (Copepoda, Calanoida) in southern New Zealand waters with notes on the male. Aust. J. Mar. Freshwat. Res. 19: 19-30.

Geog. Loc.: Southeastern New Zealand waters.
Local Taxa: *Neocalanus plumchrus*.
Annot. Source: Summary of text.

The seasonal abundance of different life history stages of *Calanus tonsus* in southeastern New Zealand waters from September to January is discussed. A review of the past confusion as to the identity and geographic distribution of *Calanus tonsus* and *C. plumchrus* is included.

Johnson, M.W. 1934a. Developmental stages of the calanoid copepod, *Epilabidocera amphitrites*. Biol. Bull. 67(3): 466-483.

Geog. Loc.: Friday Harbor, Washington, northeastern Pacific.
Local Taxa: *Epilabidocera longipedata*.
Annot. Source: Summary of text.

All naupliar and copepodite stages of *Epilabidocera amphitrites* were collected or reared, and are described and illustrated in detail.

Johnson, M.W. 1934b. The life history of the copepod Tortanus discaudatus (Thompson and Scott). Biol. Bull. 67: 182-200.

Geog. Loc.: Friday Harbor, Washington, northeastern Pacific.
Local Taxa: Tortanus discaudatus.
Annot. Source: Modified author's summary.

Identification of the pelagic eggs of Tortanus discaudatus is established by hatching larvae from eggs occurring in the plankton at Friday Harbor and also from eggs which were spawned by the species in experimental cultures. Detailed written and pictorial descriptions are given of the egg, naupliar and copepodite stages. The adults are not described.

Johnson, M.W. 1936. Pachyptilus pacificus and Centraugaptilus porcellus, two new copepods from the North Pacific. Bull. Scripps Inst. Oceanogr. Tech. Ser. 4(2): 65-70.

Geog. Loc.: North Pacific.
Local Taxa: Pachyptilus pacificus, Centraugaptilus porcellus.
Annot. Source: Summary of text.

Both sexes of Centraugaptilus porcellus and the female of Pachyptilus pacificus are described and illustrated. These two new species of bathypelagic marine copepods were identified from a sample collected at 49° 20' N, 174° 31' W in the north central Pacific.

Johnson, M.W. 1937. The developmental stages of the copepod *Eucalanus elongatus* Dana var. *bungii* Giesbrecht. Trans. Amer. Microsc. Soc. 56(1): 79-98.

Geog. Loc.: Northern Pacific.
Local Taxa: *Eucalanus bungii*.
Annot. Source: Modified author's summary.

A study of the distribution and biology of *Eucalanus elongatus* is hindered by the failure of authors to distinguish between the varieties of the species as set down by Giesbrecht (1892). It is suggested that the variety *bungii* should be raised to the rank of species and it is noted that some variation of the armature of the mandibular palp is evident within this variety. All the developmental stages of *Eucalanus elongatus* var. *bungii* from the first nauplius larva to the adult are described and illustrated.

Johnson, M.W. 1938. Concerning the copepod *Eucalanus elongatus* and its varieties in the northeast Pacific. Bull. Scripps Inst. Oceanogr. Tech. Ser. 4: 165-180.

Geog. Loc.: Northeastern Pacific.
Local Taxa: *Eucalanus bungii*, *Eucalanus californicus*, *Eucalanus*.
Annot. Source: Summary of text.

The external morphology, geographic distribution and breeding ranges of *Eucalanus elongatus* varieties are compared. Evidence is given to justify the creation of the following new species and subspecies: *Eucalanus bungii bungii*, *Eucalanus bungii californicus* and *Eucalanus inermis*. The above species are described and illustrated.

Johnson, M.W. 1939. The study of species formation in certain Eucalanus copepods in the North Pacific. Bull. Scripps Inst. Oceanogr. Tech. Ser. 106: 565-567.

Geog. Loc.: Northern Pacific.
Local Taxa: Eucalanus bungii, E. californicus.
Annot. Source: Summary of text.

A hypothesis is proposed as to the possible species formation of Eucalanus bungii bungii and E. bungii californicus from the supposedly phylogenetically older species, E. elongatus. Mori's (1937) suggestion that E. bungii be called E. giesbrechti is seen by the author as being taxonomically incorrect.

Johnson, M.W. 1942. Concerning the hitherto unknown males of the copepods Microsetella rosea (Dana), Vettoria granulosa (Giesbrecht), and Corissa parva Farran. Trans. Amer. Microsc. Soc. 61(4): 430-437.

Geog. Loc.: Pacific Ocean.
Local Taxa: Harpacticoida, Microsetella rosea.
Annot. Source: Modified author's summary.

The previously unknown males of the following species are described and illustrated in detail: Microsetella rosea (Dana) (a pelagic Harpacticoida), and Vettoria granulosa (Giesbrecht) and Corissa parva Farran (both Cyclopoida).

Johnson, M.W. 1961. On zooplankton of some Arctic coastal lagoons of northwestern Alaska, with description of a new species of *Eurytemora*. Pac. Sci. 15: 311-329.

Geog. Loc.: Northwestern Alaska, Arctic Ocean.
Local Taxa: *Eurytemora pacifica*, *Centropages abdominalis*.
Annot. Source: Summary of text.

Nine shallow lagoons bordering on the Chukchi Sea were monitored for water temperature, salinity and zooplankton populations. Observations are made on the salinity tolerances for the copepod species identified. Taxonomic notes on *Limnocalanus grimaldi*, *L. johanseni*, *Centropages abdominalis*, and *Eurytemora pacifica* are included, and a new species, *Eurytemora foveola* is described.

Katona, S.K. 1971. The developmental stages of *Eurytemora affinis* (Poppe, 1880) (Copepoda, Calanoida) raised in laboratory cultures, including a comparison with the larvae of *Eurytemora americana* Williams, 1906 and *Eurytemora herdmani* Thompson and Scott, 1897. Crustaceana 21(1): 5-20.

Geog. Loc.: Harvard University, Massachusetts.
Local Taxa: *Eurytemora affinis*, *E. americana*.
Annot. Source: Summary of text.

The life history and morphology of *Eurytemora affinis* is compared to the descriptions for *E. americana* and *E. herdmani* by Grice (1971). Ecological relationships are discussed.

Koeller, P.A. 1974. Taxonomy, distribution and aspects of the biology of some deep-living copepods in B.C. inlets and adjacent waters. M.Sc. Thesis, University of Victoria, B.C. 183 pp.

Geog. Loc.: Coastal waters of British Columbia, northeastern .
Local Taxa: Spinocalanus brevicaudatus, Scaphocalanus brevicornis, Heterorhabdus tanneri, Azygokeras columbiae, Calanus marshallae, Metridia pacifica.
Annot. Source: Summary of text.

The distribution and life cycles of three bathypelagic copepods (Spinocalanus brevicaudatus, Scaphocalanus brevicornis and Heterorhabdus tanneri) as well as two interzonal species (Calanus glacialis and Metridia pacifica) in Bute and Jervis Inlets and the Strait of Georgia were investigated. The three bathypelagic species are redescribed as well as a new species, Comantenna columbiae.

Koeller, P.A., and J.L. Littlepage. 1976. Azygokeras columbiae, a new genus and species of marine epibenthic copepod (Calanoida: Aetideidae) from British Columbia. J. Fish. Res. Bd. Can. 33: 1547-1552.

Geog. Loc.: Bute Inlet, B.C., northeastern Pacific.
Local Taxa: Azygokeras columbiae.
Annot. Source: Author's abstract.

Azygokeras columbiae n.gen., n.sp. can be distinguished from other genera of Aetideidae by the asymmetrical first antennae of the male, the setation of the first two segments of the second antennal exopod of the female, and by the spinulation on basipods and rami of the swimming legs of both sexes. The animal was found only in deep hauls from Bute Inlet and is probably an epibenthic form.

Koga, F. 1960. The nauplius larvae of *Centropages abdominalis* Sato. Bull. Jap. Soc. Sci. Fish. 26: 877-882 (In Japanese, English summary).

Geog. Loc.: Sea of Japan.
Local Taxa: *Centropages abdominalis*.
Annot. Source: Summary of author's abstract.

Eggs from *Centropages abdominalis* were reared in the laboratory through all the naupliar stages within ten days of hatching in water at 15.4° C. All the naupliar stages are fully described and illustrated.

Lang, B.T. 1965. Taxonomic review and geographic survey of the copepod genera *Eucalanus* and *Rhincalanus* in the Pacific Ocean. Ph.D. Thesis, University of California, San Diego. 300 pp.

Geog. Loc.: Pacific Ocean and Indo-Pacific region.
Local Taxa: *Eucalanus bungii*, *E. californicus*, *E. hyalinus*, *Rhincalanus nasutus*.
Annot. Source: Bio Abstract No. 65-1272, in part.

The occurrence and abundance of the 17 recognized subspecies and species of *Eucalanus* were investigated in plankton samples from more than 700 stations in the Pacific Ocean and Indo-Pacific region. The data are summarized in a series of distribution charts. Specific structural features of body form and appendages are illustrated, together with diagnostic keys and discussions of taxonomic status, synonymy, and geographical variation.

LeBour, M.V. 1916. Stages in the life history of *Calanus finmarchicus* (Gunnerus), experimentally reared by Mr. L.R. Crawshay in the Plymouth, northeastern Atlantic. Laboratory. J. Mar. Biol. Ass. N.S. 11: 1-16.

Geog. Loc.: Plymouth Laboratory, northeastern Atlantic.
Local Taxa: See note below.
Annot. Source: Summary of text.

The calanoid copepod, *Calanus finmarchicus*, was successfully reared from eggs to the adult. The first five naupliar stages and the five copepodite stages are described and illustrated in detail, but the 6th naupliar stage was missed. The adult, 6th copepodite, is not discussed.

Note: This paper is included here because the first five naupliar and copepodite stages of this species are similar to other members of this genus.

Lubbock, J. 1857. Description of eight new species of Entomostraca found at Weymouth. Ann. Mag. Nat. Hist. Ser. 2. 20: 401-410, pls. X, XI.

Geog. Loc.: Weymouth, England, northwestern Atlantic.
Local Taxa: *Corycaeus anglicus*.
Annot. Source: Summary of text.

Original descriptions are given for the following eight species of copepods: *Calanus euchaeta*, *C. anglicus*, *Diaptomus bateanus*, *D. longicaudatus*, *Pontella wollastoni*, *Pontellina brevicornus*, *Corycaeus anglicus*, *Monstrilla anglica*. The body of the text is written in English with the actual descriptions appearing in Latin.

Maclellan, D.L., and C.T. Shih. 1974. Description of copepodite stages of Chiridius gracilis Farran 1908 (Crustacea: Copepoda). J. Fish. Res. Bd. Can. 31: 1337-1349.

Geog. Loc.: Gulf of St. Lawrence.
Local Taxa: Chiridius gracilis.
Annot. Source: Author's abstract.

On the basis of specimens taken from plankton samples, all copepodite stages of Chiridius gracilis are described and illustrated. The first thoracic somite is fused with the cephalosome in adults, but an incomplete suture exists between these body parts in copepodites IV and V. The metasomal process, a prominent character of this species, appears as a small blunt process as early as copepodite I and becomes fully developed by copepodite IV. Segmentation of mouthparts is complete by copepodite IV but full setation is not acquired until the adult stage. The mandible, maxillule, and maxilla degenerate in the adult male. Segmentation and setation of swimming legs are complete in copepodite V in the female and in the adult male.

McMurrich, J.P. 1916. Notes on the plankton of the British Columbia coast. Trans. Roy. Soc. Can. 10. Ser. 3. Sect. 5: 75-84.

Geog. Loc.: Coast of British Columbia.
Local Taxa: Corycaeus affinis, Epilabidocera longipedata.
Annot. Source: Summary of text.

Observations of phytoplankton and zooplankton from a 1912 cruise in Puget Sound and the Strait of Georgia are discussed. Brief mentions are made of Anthomedusae, Siphonophora and the more abundant Crustacea. One species of cyclopoid copepod, Corycaeus affinis, and one new genus and species of calanoid copepod, Paralabidocera amphitrites, are described.

McMurrich, J.P. 1917. Notes on some crustacean forms occurring in the plankton of Passamaquoddy Bay. Trans. Roy. Soc. Can. Sect. IV: 47-61.

Geog. Loc.: Passamaquoddy Bay, northwestern Atlantic.
Local Taxa: *Monstrilla canadensis*.
Annot. Source: Summary of text.

A new species of monstrilloid copepod, *Monstrilla canadensis*, is described from a single male specimen. Additional notes on other parasitic crustaceans are also discussed.

Marukawa, M. 1921. Plankton list and some new species of copepods from the northern waters of Japan. Bull. Inst. Oceanogr. Monaco 384: 1-15.

Geog. Loc.: Northern waters of Japan.
Local Taxa: *Neocalanus plumchrus*, *Euchaeta elongata*.
Annot. Source: Summary of text.

One hundred sixty-four plankton species were identified from samples taken from May to October 1915 in the North Pacific, and the Okhotsk and Japan Seas. The following four species of calanoid copepods are described for the first time: *Calanus plumchrus*, *Eucalanus oculanus*, *Euchaeta japonica*, and *Pseudolovenula magna*.

Mori, T. 1937. The pelagic Copepoda from the neighboring waters of Japan. The Soya Co. Inc., Tokyo. 150 pp., 80 pls.

Geog. Loc.: Coastal waters of Japan, northwestern Pacific.
Local Taxa: Calanoida, Cyclopoida, Harpacticoida.
Annot. Source: Summary of text.

An identification key to 179 species of pelagic marine calanoid, cyclopoid and harpacticoid copepods is given. Thirty-two of these are found in British Columbia coastal waters. Most species are described and illustrated. Ten species are new to science.

Morris, B. 1970. Calanoid copepods from midwater trawls in the North Pacific along 160°E. J. Fish. Res. Bd. Can. 27: 2297-2321.

Geog. Loc.: North Pacific (160°E).
Local Taxa: *Gaidius pungens*.
Annot. Source: Author's abstract.

Ninety-nine species of calanoid copepods were identified from 29 midwater-trawl samples taken at ten stations in the subarctic, transitional, and subtropical regions of the North Pacific. Fourteen species are discussed, including the previously unknown male of *Gaidius pungens* and three species in the *Scottocalanus helenae* group. There are nine new records of species from the study area.

Mullin, M.M. 1969. Distribution, morphometry and seasonal biology of the planktonic copepods, *Calanus tenuicornis* and *Calanus lighti*, in the Pacific Ocean. Pac. Sci. 23: 438-446.

Geog. Loc.: North Pacific.
Local Taxa: *Mesocalanus tenuicornis*.
Annot. Source: Summary of text.

The geographical and vertical distribution, reproductive cycles and character displacement in body size and mouthparts of the sibling species *Calanus tenuicornis* and *C. lighti* in the North and South Pacific were investigated. Bowman's (1955) descriptions were found to be adequate in making a clear distinction between the two species in most of the Pacific. An intermediate form was found in the South Pacific at latitudes higher than 40°. *Calanus lighti* was concluded to be an ecophenotype of *C. tenuicornis* since the 'pure' forms were absent in the area in which it occurs.

Murphy, H.E. 1923. The life cycle of *Oithona nana* reared experimentally. Univ. Calif. Publ. Zool. 22: 449-454.

Geog. Loc.: Scripps Institute, California, northeastern Pacific.
Local Taxa: *Oithona*.
Annot. Source: Summary of text.

Oithona nana was reared through two generations in the first successful culture of a marine copepod. Average body length and duration of each stage is recorded. Sexual differentiation was possible after the third naupliar stage. A key to naupliar and copepodite stages is included.

Omori, M. 1965a. A new species of *Euchirella* (Copepoda) from Sagami Bay, Middle Japan. J. Oceanogr. Soc. Jap. 21: 60-65.

Geog. Loc.: Sagami Bay, Japan, northwestern Pacific.
Local Taxa: *Euchirella pulchra*.
Annot. Source: Modified author's abstract.

A new species of calanoid copepod, *Euchirella tanseii*, is described. The species closely resembles *Euchirella venusta* Giesbrecht and *E. pulchra* (Lubbock), but can be distinquished by the shape of the genital segment and the number of setae on the 2nd segment of the endopodite of the second antenna. A comparison of systematic characters of these species is attempted.

Owre, H.B. and M. Foyo. 1967. Copepods of the Florida current. Fauna Caribaea. No. 1. Crustacea, Part 1: Copepoda. Institute of Marine Science. University of Miami. 137 pp.

Geog. Loc.: Caribbean Sea.
Local Taxa: Calanoida, Cyclopoida, Harpacticoida.
Annot. Source: Summary of the text.

The primary dichotomous key in this book differentiates the many genera of calanoid, cyclopoid and harpacticoid copepods inhabiting the Florida current. Secondary keys to species are arranged in taxonomic order and include distributional notes for each species. All the keys are illustrated with line drawings and/or photographs.

Park, T. 1965. The biology of a calanoid copepod Epilabidocera amphitrites McMurrich. Ph.D. Thesis, Univ. Wash., Seattle. 320 pp.

Geog. Loc.: Washington, northeastern Pacific.
Local Taxa: Epilabidocera longipedata.
Annot. Source: Summary of text.

Particular emphasis is placed on the internal anatomy and functional morphology of Epilabidocera amphitrites. The external anatomy of both the female and male are described in detail.

Park, T. 1966a. A new species of Bradyidius (Copepoda: Calanoida) from the Pacific Coast of North America. J. Fish. Res. Bd. Can. 23: 805-811.

Geog. Loc.: Saanich Inlet, B.C., northeastern Pacific.
Local Taxa: Bradyidius saanichi, B. similis.
Annot. Source: Author's abstract.

A new species, Bradyidius saanichi, from Saanich Inlet Vancouver Island, British Columbia, is described and illustrated. This species is closely related to B. pacificus (Brodsky, 1950). It can readily be distinguished from the latter by the strongly divergent rostral rami, in addition to other differences.

Park, T. 1966b. The biology of a calanoid copepod *Epilabidocera amphitrites* McMurrich. La Cellule 66: 127-252, 10 pls.

Geog. Loc.: Friday Harbor, Washington, northeastern Pacific.
Local Taxa: *Epilabidocera amphitrites*.
Annot. Source: Summary of text.

All aspects of the biology of an adult calanoid copepod, *Epilabidocera amphitrites*, are discussed. Included are detailed taxonomic descriptions and drawings of the adult male and female. The juvenile forms are not discussed.

Park, T. 1967a. Two unreported species and one new species of *Monstrilla* (Copepoda: Monstrilloida) from the Strait of Georgia. Trans. Amer. Microsc. Soc. 86(2): 144-152.

Geog. Loc.: Strait of Georgia, B.C., northeastern Pacific.
Local Taxa: Monstrilloid copepods, *Monstrilla wandelii*, *M. helgolandica*, *M. spinosa*.
Annot. Source: Author's abstract.

Three species of *Monstrilla* from the Strait of Georgia, British Columbia, are described and illustrated in detail. Two of these, *M. wandelii* Stephensen and *M. helgolandica* Claus, have not previously been reported from this area, and the male of the former is here described for the first time. The other species, *M. spinosa*, is new.

Park, T. 1967b. Two new species of calanoid copepods from the Strait of Georgia, British Columbia, Canada. J. Fish. Res. Bd. Can. 24(2): 231-242.

Geog. Loc.: Strait of Georgia, B.C., northeastern Pacific.
Local Taxa: *Gaidius minutus*, *Tharybis fultoni*.
Annot. Source: Author's abstract.

Two new species, *Gaidius columbiae* and *Tharybis fultoni*, from the Strait of Georgia, British Columbia, are described and illustrated in detail. The former can be distinguished from all previously known species of its genus by the shape of the postero-lateral process of the metasome, and the latter by the shape of the 5th pair of legs.

Park, T. 1968. Calanoid copepods from the central north Pacific Ocean. Fishery Bull. Fish Wildl. Serv. U.S. 66(3): 527-572.

Geog. Loc.: Central North Pacific.
Local Taxa: Calanoida, *Euchaeta media*.
Annot. Source: Summary of text.

A collection of 64 species of calanoid copepods was obtained from the central North Pacific Ocean. Of these, 20 species are known to occur in British Columbia coastal waters. Remarks on distribution, total body length and diagnostic characters are included for each species. The male of *Euchaeta media* is redescribed and two forms of adult and stage V copepodite *Eucalanus attenuatus* are described at length. Many drawings are included in the text.

Park, T. 1973. Redescription of *Gaetanus intermedius* Campbell (Calanoida: Copepoda) from the type locality. J. Fish. Res. Bd. Can. 30: 1597-1600.

Geog. Loc.: Washington Sound, Washington, Strait of Georgia and Queen Charlotte Islands, B.C., northeastern Pacific.
Local Taxa: *Gaetanus intermedius*, *G. simplex*, *G. minor*, *G. armiger*.
Annot Source: Author's abstract.

Gaetanus intermedius Campbell, 1930, is redescribed from specimens taken in the type locality, the Vancouver Island region in the northeastern Pacific. *Gaetanus simplex* Brodsky, 1950 is found to be a junior synonym of *G. intermedius*.

Park, T. 1975a. Calanoid copepods of the genera *Gaetanus* and *Gaidius* from the Gulf of Mexico. Bull. Mar. Sci. 25(1): 9-34.

Geog. Loc.: Gulf of Mexico.
Local Taxa: *Gaetanus intermedius*, *G. miles*, *G. pileatus*, *Gaidius minutus*, *G. pungens*, *G. variabilis*.
Annot. Source: Modified author's abstract.

The union of the genus *Gaidius* Giesbrecht with *Gaetanus* Giesbrecht is proposed, with a brief review of all the species so far described for the genera. Ten species of *Gaetanus* collected from the Gulf of Mexico are described and illustrated. The males of *G. armiger*, *G. brachyurus*, *G. latifrons*, *G. miles*, *G. minor* and *G. minutus* are described here for the first time. A key to the species of *Gaetanus* from the Gulf of Mexico is given.

Park, T. 1975b. Calanoid copepods of the genera *Aetideopsis*, *Pseudaetideus* and *Chiridius* from the Gulf of Mexico. Bull. Mar. Sci. 25(2): 272-290.

Geog. Loc.: Gulf of Mexico.
Local Taxa: *Chiridius gracilis*.
Annot. Source: Modified author's abstract.

Descriptions and illustrations are given for calanoid copepods of the genera *Aetideopsis*, *Pseudaetideus*, and *Chiridius* found in the Gulf of Mexico, including two new species of *Chiridius* (*C. subgracilis* and *C. mexicanus*). The genus *Pseudaetidius* is considered synonymous with *Aetideopsis*.

Park, T. 1976a. A new species of *Euchirella* (Copepoda, Calanoida) from the Pacific coast of North America with notes on *Euchirella pulchra* (Lubbock). Crustaceana 31(2): 208-212.

Geog. Loc.: Washington Sound, northeastern Pacific.
Local Taxa: *Euchirella pseudopulchra*, *E. pulchra*.
Annot. Source: Summary of text.

Specimens of *Euchirella pulchra* from Washington Sound, Gulf of Mexico, Caribbean Sea, Canary Island area, and Gulf of Guinea were examined, resulting in the recognition of the northeastern Pacific population as being distinct from the others. A new species, *E. pseudopulchra*, is described for the first time. *Euchirella pulchra* is redescribed for characters useful in distinguishing it from the new species.

Park, T. 1976b. Calanoid copepods of the genus Euchirella from the Gulf of Mexico. Contr. Mar. Sci. 20: 101-122.

Geog. Loc.: Gulf of Mexico.
Local Taxa: Euchirella rostrata, E. pulchra, E. curticauda.
Annot. Source: Modified author's abstract.

During the examination of 93 zooplankton tows taken from various depth ranges between the surface and 3000m, 5622 specimens belonging to nine Euchirella species were found. Each of these species is described and illustrated. The relative abundance and bathymetrical distribution of each species by day and night are briefly discussed. A key to the species is given.

Park, T. 1977. Redescription of Euchaeta californica Esterly and Euchaeta dubia Esterly (Copepoda, Calanoida). Crustaceana 32(2): 135-138.

Geog. Loc.: Coast of California, northeastern Pacific.
Local Taxa: Euchaeta californica.
Annot. Source: Summary of text.

Euchaeta californica is redescribed from Esterly's type specimen and from other specimens from the type area. Euchaeta dubia is considered to be the male of E. californica and is so described. The synonymy of the species is summarized, including references to E. californica and E. dubia which are considered to be incorrect.

Park, T. 1978. Calanoid copepods (Aetideidae and Euchaetidae) from Antarctic and sub-Antarctic waters. Antarctic Res. Ser. 27: 91-290.

Geog. Loc.: Antarctic and sub-Antarctic waters.
Local Taxa: *Chiridius gracilis*, *C. polaris*, *Gaetanus pileatus*, *Euchirella rostrata*, *Pseudochirella polyspina*, *Chirundina streetsi*, *Euchaeta media*, *E. spinosa*.
Annot. Source: Modified author's abstract.

Sub-Antarctic and Antarctic calanoid copepods belonging to the families Aetideidae and Euchaetidae are the subject of this key. Sixty-two species representing 13 genera are described and illustrated from specimens collected in sub-Antarctic and Antarctic waters. Twelve species are described for the first time.

Park, T. 1980. Calanoid copepods of the genus *Scolecithricella* from Antarctic and sub-Antarctic waters. *Antarctic Res. Ser. 31: 25-79.*

Geog. Loc.: Antarctic and sub-Antarctic waters.
Local Taxa: *Scolecithricella minor*, *S. ovata*, *S. emarginata*.
Annot. Source: Modified author's abstract.

Seventy-four Issac-Kidd midwater trawls and 66 bongo plankton net samples from Antarctic and sub-Antarctic waters have been examined for the calanoid genus *Scolecithricella*. Nineteen species are new to science, two species are new records to the area, and three species represented solely by males are not identified. All species are characterized with descriptions and illustrations. Keys are presented for identification of the species.

Rose, M. 1933. Copepodes pelagiques. Faune de France. 26: 1-374.

Geog. Loc.: Northeastern Atlantic.
Local Taxa: Calanoida, Harpacticoida, Cyclopoida, Monstrilloida.
Annot. Source: Summary of text.

The pelagic marine calanoids, harpacticoids, cyclopoids, and monstrilloids of the northeastern Atlantic are reviewed. Keys and taxonomic descriptions are given for the order, family, genus and species levels. Forty-eight of the species discussed occur in British Columbia coastal waters.

Sars, G.O. 1903. An account of the Crustacea of Norway. Vol. 4. Copepoda, Calanoida. Bergen Mus. Press, Norway. 167 pp., 108 pls.

Geog. Loc.: Northeastern Atlantic.
Local Taxa: Calanoida.
Annot. Source: Summary of text.

Descriptions and illustrations of pelagic marine calanoid copepods collected in Norwegian waters are given, with many of the genera and species being described for the first time. No identification keys are included.

Sars, G.O. 1905. Liste preliminaire des calanoides recueillis pendant les campagnes de S.A.S. Le Prince Albert de Monaco, avec diagnoses des genres et des especes nouvelles (1re partie). Bull. Inst. Oceanogr. Monaco 26: 1-2.

Geog. Loc.: Northeastern Atlantic.
Local Taxa: *Onchocalanus*.
Annot. Source: Summary of text.

A species list of 79 calanoid copepods is given. Of these, five genera and 30 species are new to science and have been described. No illustrations are included.

Sars, G.O. 1907. Notes supplementaires sur les calanoides de la Princesse-Alice (corrections et additions). Bull. Inst. Oceanogr. Monaco 101: 1-27.

Geog. Loc.: North Atlantic.
Local Taxa: *Gaidius minutus*.
Annot. Source: Summary of text.

Thirty-one species of calanoid copepods are described but not illustrated. Earlier taxonomic decisions are revised.

Sars, G.O. 1916. Liste systematique des cyclopoides, harpacticoides et monstrilloides recueillis pendant les campagnes de S.A.S. le Prince Albert de Monaco, avec descriptions et figures des especes nouvelles. Bull. Inst. Oceanogr. Monaco 323: 1-15, pl. VIII.

Geog. Loc.: North Atlantic and Mediterranean.
Local Taxa: *Oithona spinirostris*, *O. similis*, *Macrocheiron sargassi*.
Annot. Source: Summary of text.

A species list, including synonymies, of cyclopoid, harpacticoid and monstrilloid copepods obtained from expeditions of the Prince Albert de Monaco is presented. Only new genera and species are described and illustrated.

Sars, G.O. 1913-18. An account of the Crustacea of Norway: Vol. VI. Copepoda: Cyclopoida. Publ. Bergen Mus., Norway. 225 pp., 118 pls.

Geog. Loc.: Northeastern Atlantic.
Local Taxa: *Oithona spinirostris*, *O. similis*, *Corycaeus anglicus*, *Oncaea borealis*, *Macrocheiron sargassi*.
Annot. Source: Summary of text.

Descriptions and illustrations of pelagic marine cyclopoid copepods collected in Norwegian waters are given. Many of the genera and species are described for the first time. No identification keys are included.

Sars, G.O. 1920. Calanoides recueillis pendant les campagnes de S.A.S. le Prince de Monaco. Bull. Inst. Oceanogr. Monaco 377: 1-20.

Geog. Loc.: Northeastern Atlantic.
Local Taxa: *Pseudochirella*, *Heterostylites*, *Centraugaptilus*.
Annot. Source: Summary of text.

Thirty-four rare species are described and nine new genera erected, but no illustrations are included.

Semenova, T.N. 1962. On the diagnostics of the species *Spinocalanus brevicaudatus* Brodskii, 1950 (Copepoda, Calanoida). Zool. Zhur. 41: 1571-1574 (in Russian, English summary).

Geog. Loc.: North Atlantic.
Local Taxa: *Spinocalanus brevicaudatus*.
Annot. Source: English summary.

On the basis of morphological analyses of the material collected in the waters surrounding Newfoundland (Grand Banks), and in the southern Norwegian Sea, the author suggests changes in the diagnostics and description of the species *Spinocalanus brevicaudatus*.

Shih, C-T., A.J.G. Figueira, and E.H. Grainger. 1971. A synopsis of Canadian marine zooplankton. Fish. Res. Bd. Can. Bull. 176. Ottawa. 264 pp.

Geog. Loc.: Canadian coastal waters.
Local Taxa: All Canadian marine zooplankton.
Annot. Source: Author's abstract.

A compilation of the literature published prior to 1970 on marine zooplankton of Canadian waters is presented in three sections: Atlantic, Pacific, and Arctic, each containing records of species and a bibliography. An integrated index of generic and specific names for all three regions is included.

Shih, C.-T., L. Rainville, and D.C. Maclellan. 1981. Copepodids of *Bradyidius similis* (Sars 1902) (Crustacea:Copepoda) and their distribution in the *Saguenay* fjord and the St. Lawrence estuary. Can. J. Zool. 59(6): 1079-1102.

Geog. Loc.: St. Lawrence River, northwestern Atlantic.
Local Taxa: *Bradyidius similis*.
Annot. Source: *Modified authors'* abstract.

All copepodite stages of *Bradyidius similis* are described and illustrated, and the source and distribution of the species in the study area are discussed.

Shmeleva, A.A. 1966. New species of the genus *Oncaea* (Copepoda, Cyclopoida) from the Adriatic Sea. Zool. Zhur. 66: 932-936 (in Russian, English summary).

Geog. Loc.: Adriatic Sea.
Local Taxa: *Oncaea ivlevi*.
Annot. Source: English summary.

Four new species, *Oncaea ivlevi*, *O. prendeli*, *O. zernovi*, and *O. ovalis* from the south Adriatic Sea are described. The depth, temperature and salinity at which these copepods were found are mentioned.

Shmeleva, A.A. 1969. Espèces nouvelles du genre *Oncaea* (Copepoda, Cyclopoida) de la mer Adriatique. Bull. Inst. Oceanogr. Monaco 68(1393): 1-28.

Geog. Loc.: Adriatic Sea.
Local Taxa: *Oncaea ivlevi*.
Annot. Source: Modified English Summary.

Descriptions are given for eleven new species of *Oncaea* collected during plankton sampling of the U.S.S.R. RV Kristall (1958) and the Akademy Kovolevsky (1959, 1960) in the Adriatic Sea. Descriptions include collection stations and depths. Also given is a key to all known species of the genus *Oncaea* from the Mediterranean.

Tanaka, O. The pelagic copepods of the Izu Region, Middle Japan. Publications of the Seto Marine Biological Laboratory. Various issues (see below).

Geog. Loc.: Izu Region, Middle Japan.
Local Taxa: Calanoida.
Annot. Source: Summary of papers.

In an extensive series of publications, the author has revised and described all the known species of calanoid copepods occurring in the Izu Region. Detailed taxonomic drawings accompany each species description.

The list of these publications is as follows:

Tanaka, O. 1956b. The pelagic copepods of the Izu Region, Middle Japan. Systematic account. I. Families Calanidae and Eucalanidae. Publ. Seto Mar. Biol. Lab. 5(2): 251-272.

_________. 1956c. The pelagic copepods of the Izu Region, Middle Japan. Systematic Account II. Families Paracalandae and Pseudocalanidae. Publ. Seto Mar. Biol. Lab. 5(3): 367-406.

_________. 1957a. The pelagic copepods of the Izu Region, Middle Japan. Systematic Account III. Family Aetideidae, Part I. Publ. Seto Mar. Biol. Lab. 6(1): 31-68.

_________. 1957b. The pelagic copepods of the Izu Region, Middle Japan. Systematic Account IV. Family Aetideidae, Part II. Publ. Seto Mar. Biol. Lab. 6(2): 169-207.

_________. 1958. The pelagic copepods of the Izu Region, Middle Japan. Systematic Account V. Family Euchaetidae. Publ. Seto Mar. Biol. Lab. 6(3): 327-367.

_________. 1960a. The pelagic copepods of the Izu Region, Middle Japan. Systematic Account VI. Families Phaennidae and Tharybidae. Publ. Seto Mar. Biol. Lab. 8(1): 85-135.

_________. 1961. The pelagic copepods of the Izu Region, Middle Japan. Systematic Account VII. Family Scolecithricidae, Part I. Publ. Seto Mar. Biol. Lab. 9 (1): 139-190.

_________. 1962. The pelagic copepods of the Izu Region, Middle Japan. Systematic Account VIII. Family Scolecithricidae, Part II. Publ. Seto Mar. Biol. Lab. 10(1): 35-90.

_________. 1963. The pelagic copepods of the Izu Region, Middle Japan. Systematic Account IX. Families Centropagidae, Pseudodiaptomidae, Temoridae, Metridiidae and Lucicutiidae. Publ. Seto Mar. Biol. Lab. 11(1): 7-55.

________. 1964a. The pelagic copepods of the Izu Region, Middle Japan. Systematic Account X. Family Heterorhabdidae. Publ. Seto Mar. Biol. Lab. 12(1): 1-37.

________. 1964b. The pelagic copepods of the Izu Region, Middle Japan. Systematic Account XI. Family Augaptilidae. Publ. Seto Mar. Biol. Lab. 12(1): 39-91.

________. 1964c. The pelagic copepods of the Izu Region, Middle Japan. Systematic Account XII. Families Arietellidae, Pseudocyclopidae, Candaciidae and Pontellidae. Publ. Seto Mar. Biol. Lab. 12(3): 231-271.

Tanaka, O., and M. Omori. 1968. Additional report on calanoid copepods from the Izu Region. Part I. Euchaeta and Pareuchaeta. Publ. Seto Mar. Biol. Lab. 16(4): 219-261.

Tanaka, O., and M. Omori. 1969a. On Euchirella (Copepoda, Calanoida) collected chiefly by the U.S. Steamer 'Albatross' from the Pacific Ocean. Publ. Seto Mar. Biol. Lab. 17(1): 33-65.

Tanaka, O., and M. Omori. 1969b. Additional report on calanoid copepods from the Izu Region. Part II. Euchirella and Pseudochirella. Publ. Seto Mar. Biol. Lab. 17(3): 155-169.

Tanaka, O., and M. Omori. 1970a. Additional reports from the Izu Region. Part 3-A. Euaetidius, Aetideopsis, Chiridius, Gaidius and Gaetanus. Publ. Seto Mar. Biol. Lab. 18(2): 109-141.

Tanaka, O., and M. Omori. 1970b. Additional reports from the Izu Region. Part 3-B. Chirundina, Undeuchaeta, Pseudeuchaeta, Valdiviella and Chiridiella. Publ. Seto Mar. Biol. Lab. 18(3): 143-155.

Tanaka, O., and M. Omori. 1971. Additional report from the Izu Region. Part IV. Haloptilus, Augaptilus, Centraugaptilus, Pseudaugaptilus, and Pachyptilus. Publ. Seto Mar. Biol. Lab. 19(4): 249-268.

Tanaka, O., and M. Omori. 1974. Additional report on calanoid copepods from the Izu region. Part V. Enaugaptilus. Publ. Seto Mar. Biol. Lab. 21(3/4): 193-267.

Tanaka, O. 1937. Copepods from the deep water of Suruga Bay. Jap. J. Zool. 7: 251-271.

Geog. Loc.: Sizuoka-Ken, northwestern Pacific.
Local Taxa: *Clausocalanus arcuicornus*, *Ctenocalanus vanus*, *Chiridius gracilis*, *Heterorhabdus papilliger*.
Annot. Source: Summary of text.

The genus *Paratharybis* is erected for *P. frontalis*, and two new species, *Xanthocalanus media* and *Scaphocalanus minuta*, are described from a vertical haul from 500 to 250 m. Twenty-one species were identified.

Tanaka, O. 1954. Note on *Calanus tonsus* Brady in Japanese waters. J. Oceanogr. Soc. Jap. 10(1): 1-39.

Geog. Loc.: Sea of Japan, northwestern Pacific Ocean.
Local Taxa: *Neocalanus plumchrus*.
Annot. Source: Author's synopsis.

Immature specimens of *Calanus tonsus* Brady are described.

Tanaka, O. 1956a. Further note on *Calanus tonsus* Brady in Japanese waters. J. Oceanogr. Soc. Jap. 12(2): 1-4.

Geog. Loc.: Antarctic waters, northern Pacific.
Local Taxa: *Neocalanus plumchrus*.
Annot. Source: Author's abstract.

Calanus plumchrus is shown to be distinct from *C. tonsus* Brady, and is described as a characteristic copepod of the North Pacific.

Tanaka, O. 1969. Some calanoid copepods collected chiefly by the U.S. Steamer 'Albatross' from the Pacific Ocean. Publ. Seto Mar. Biol. Lab. 17(4): 253-278.

Geog. Loc.: Pacific Ocean.
Local Taxa: *Lophothrix frontalis*.
Annot. Source: Summary of text.

During the re-examination of specimens from the Wilson collections (U.S.N.M.), 17 species of calanoid copepods other than *Euchirella* were found from 46 vials labelled as *Euchirella*. Three species, *Gaetanus minispinus*, *Scottocalanus infrequens*, and *Wilsonidius alaskaensis*, are new to science and have been described. An immature *Lophothrix frontalis* male was found and its fifth legs have been illustrated.

Thorp, A.C. 1980. Comparative morphology of sibling species of *Metridia*: (Copepoda: Calanoida) *M. lucens*, *M. pacifica* and a species indeterminata from Indian Arm, British Columbia. M.Sc. Thesis. Univ. British Columbia, Vancouver.

Geog. Loc.: Indian Arm, B.C., northeastern Pacific.
Local Taxa: *Metridia lucens*, *M. pacifica*.
Annot. Source: Summary of author's abstract.

Metridia lucens from the northwestern Atlantic is compared with *M. pacifica* from the northeastern Pacific. The fifth pair of legs on adult males and females were examined and findings indicate errors in the original description of both species. Both these species are redescribed and illustrated as is a *Metridia* sp. collected from Indian Arm.

Trinast, E.M. 1976. A preliminary note on *Acartia californiensis*, a new calanoid copepod from Newport Bay, California. Crustaceana 31(1): 54-58.

Geog. Loc.: Newport Bay, California, northeastern Pacific.
Local Taxa: *Acartia californiensis*.
Annot. Source: Summary of text.

Both the male and female of a new species of calanoid copepod, *Acartia californiensis*, is fully described and illustrated.

Vervoort, W. 1950. The genus *Onchocalanus*. G.O. Sars, 1805 (Crustacea: Copepoda). Zool. Verh. 10: 1-35.

Geog. Loc.: Global.
Local Taxa: *Onchocalanus magnus*.
Annot. Source: Summary of text.

The genus *Onchocalanus* is discussed and a key to adult females of the eight known species is presented. Two species are described for the first time (*O. scotti*, *O. wolfendeni*), four are redescribed (*O. cristatus*, *O. magnus*, *O. affinis*, *O. trigoniceps*) and two are discussed briefly (*O. subcritatus*, *O. hirtipes*).

Vervoort, W. 1963. Pelagic Copepoda. Part I. Copepoda Calanoida of the families Calanidae up to and including Euchaetidae. Atlantide Rep. 7: 77-194.

Geog. Loc.: Southeastern Atlantic.
Local Taxa: Various.
Annot. Source: Summary of text.

An extensive collection of pelagic copepods was obtained from the waters bordering tropical West Africa. This report deals with the taxonomy of the calanoid copepods from the families Calanidae through Euchaetidae, and includes remarks on synonymies, distributional records and taxonomic problems. Fifteen species found in British Columbia waters are included.

Vervoort, W. 1965. Pelagic Copepoda. Part II. Copepoda Calanoida of the families Phaennidae up to and including Acartiidae, containing the description of a new species of Aetideidae. Atlantide Rep. 8: 9-216.

Geog. Loc.: Southeastern Atlantic.
Local Taxa: Various.
Annot. Source: Summary of text.

This report concludes the description of the Calanoida begun in Part I. Twenty-four species found in British Columbia waters are included.

Vidal, J. 1971. Taxonomic guides to Arctic zooplankton. IV. Key to the calanoid copepods of the central Arctic Ocean. Univ. South Calif. Tech. Rpt. 5: 1-128.

Geog. Loc.: Central Arctic Ocean.
Local Taxa: Calanoida.
Annot Source: Modified author's abstract.

All species known from the central Arctic Ocean, including new taxa, are keyed and illustrated, but no species descriptions are provided in this work intended for the non-specialist.

Willey, A. 1920. Report of the Canadian Arctic Expedition, 1913-1918. Vol. VII: Crustacea. Part K: Marine Copepoda. 46 pp., 70 figs.

Geog. Loc.: Canadian Arctic, British Columbia coastal waters, northeastern Pacific.
Local Taxa: *Centropages abdominalis*, *Eurytemora pacifica*.
Annot. Source: Summary of text.

Distributional and some taxonomic information on the 33 identified species is presented. The following species are described for the first time: *Centropages mcmurrichi*, *Eurytemora johanseni*, *Acartia tumida*, and *Thaumaleus bernardensis*.

Williams, L.W. 1906. Notes on marine Copepoda of Rhode Island. Amer. Nat. 40: 649-660.

Geog. Loc.: Narragansett Bay, R.I., northwestern Atlantic.
Local Taxa: *Eurytemora americana*.
Annot. Source: Summary of text.

Twenty-six free-swimming copepods, one parasitic form, and a metanauplius of a parasitic copepod are described. Samples were taken during the summer and winter from the Narragansett Bay region. Three new species, *Pseudodiaptomus coronatus*, *Eurytemora americana*, and *Tortanus setacaudatus* are described and illustrated.

Wilson, C.B. 1950. Copepods gathered by the United States Fisheries Steamer Albatross from 1887 to 1909, chiefly in the Pacific Ocean. Bull. U.S. Natl. Mus. 100. 14(4): 141-441.

Geog. Loc.:	Global.
Local Taxa:	Various.
Annot. Source:	Summary of text.

Listed are 472 species of pelagic marine copepods collected during seven voyages of the steamship Albatross between 1887-1910. The format is not that of a systematic treatise but rather an alphabetical listing of each species giving synonyms and collection stations, followed by some general notes on distribution and abundance. Twenty-nine new species are described and illustrated.

Wilson, M.S. 1966. The nominate subgenus in the genus _Acartia_ (Copepoda: Calanoida). Crustaceana 11(1): 109.

Geog. Loc.:	Global.
Local Taxa:	_Acartia_.
Annot. Source:	_Summary_ of text.

Acartia negligens is named as the type species of _Acartia_, of which _Planktacartia_ is a junior synonym.

Woodhead, P.M.J., and J.D. Riley. 1957. The separation of potential males and females in stage-V copepodites of Calanus helgolandicus. J. Cons. Perm. Int. Explor. Mer 23: 47-50.

Geog. Loc.: English Channel, northeastern Atlantic.
Local Taxa: Calanus.
Annot. Source: Author's summary.

A method for separating the sexes in the stage-V copepodite of Calanus helgolandicus, by examination of the proximal segment of the urosome, is suggested. In potential females, the ventral surface of the segment is more markedly curved, and the curve extends further forward than in potential males. Biometrical separation also revealed two groups within the stage-V copepodites, and the very close agreement obtained between this method and the urosome method of separation suggested strongly that the two groups described were indeed potential males and females. No geographical or seasonal variation in the biometrical ratios were found in the North Sea samples examined.

Woodhead, P.M.J., and J.D. Riley. 1959. Separation of the sexes of Calanus finmarchicus (Gunn.) in the fifth copepodite stage, with comments on the sex ratio and the duration in this stage. J. Cons. Perm. Int. Explor. Mer 24: 465-471.

Geog. Loc.: North Sea.
Local Taxa: Calanus.
Annot. Source: Author's abstract, in part.

Population differences in measurements made on C. helgolandicus both in the English Channel and in the North Sea are used to confirm a method for separating the sexes of C. helgolandicus in Stage V by examination of the urosome. A similar method for the separation of the sexes in Stage V of C. finmarchicus is described, then used to determine the sex ratio in this stage, and to achieve an estimate of the duration of the fifth copepodite stage in the North Sea.

Woodhouse, C.D. 1971. A study of the ecological relationships and taxonomic status of two species of the genus *Calanus* (Crustacea: Calanoida). Ph.D. Thesis, University of British Columbia, Vancouver. 175 pp., 19 pls.

Geog. Loc.: Northeastern Pacific.
Local Taxa: *Calanus pacificus*, *C. marshallae*.
Annot. Source: Modified author's abstract.

A general account is provided of the distribution and ecology of *C. glacialis* and *C. pacificus californicus* from Glacier Bay, Alaska to the Mexican border. The two species are differentiated based on the following morphological characteristics: overall length, shape of anterior surface of cephalothorax, and differences in urosome and fifth legs. Detailed analysis of ecological relationships between the two species in Indian Arm, Vancouver, B.C., indicates spatial and temporal separation of breeding populations, confirming that despite range overlaps, the two species are distinct.

Woods, S.M. 1969. Polyteny and size variation in the copepod *Pseudocalanus* from two semi-landlocked fiords on Baffin Island. J. Fish. Res. Bd. Can. 26: 543-556.

Geog. Loc.: Eastern Canadian Arctic.
Local Taxa: *Pseudocalanus*.
Annot. Source: Modified author's abstract.

Two forms of the copepod *Pseudocalanus*, which differ only in size, coexist in two semi-landlocked fiords on Baffin Island. The larger form possesses the same number of chromosomes as the smaller, but the chromosomes are larger and contain about seven times as much DNA. This larger form has a greater cell size, slower development rate, and later maturity, possibly representing an evolutionary attempt to restore normal arctic size and development rate in cold water fiords. Although this larger polytene form may be a new species, no name is given due to the indefinite taxonomy of the genus.

Yamada, T. 1971. Taxonomical view of *Calanus pacificus* var. *japonicus* Brodsky and its distributional ecology in the western Seas of Kyushu. Bull. Nagasaki Univ. Fac. Fish. 32: 51-68 (in Japanese, English summary).

Geog. Loc.: Western Seas of Kyushu Island, Japan, northwestern Pacific.
Local Taxa: *Calanus pacificus*.
Annot. Source: Modified English summary.

Specimens identified as *Calanus helgolandicus* in the study area are attributed to *C. pacificus* var. *japonicus*. Two other varieties of *C. pacificus* were not found.

10.1 INDEX TO ANNOTATED BIBLIOGRAPHY

CALANOIDA

Acartia
Sars, 1903
Willey, 1920

Acartia cf. *clausi*
Bradford, 1976
Brodsky, 1948
Campbell, 1929a
Carillo et al., 1974
Conover, 1956
Davis, 1949b
Esterly, 1924
Faber, 1966
Mori, 1937
Rose, 1933

Acartia californiensis
Trinast, 1976

Acartia danae
Bradford, 1976
Brodsky, 1962
Davis, 1949b
Grice, 1961
Mori, 1937
Park, 1968
Rose, 1933
Vervoort, 1965

Acartia longiremis
Bradford, 1976
Brodsky, 1948
Campbell, 1929a
Mori, 1937
Rose, 1933
Sars, 1903

Aetideus
Bradford, 1971a
Sars, 1903

Aetideus divergens
Campbell, 1929a
Davis, 1949b
Mori, 1937
Rose, 1933
Vervoort, 1963

Aetideus pacificus
Brodsky, 1950
Park, 1968

Arietellus plumifer
Rose, 1933
Vervoort, 1965

Azygokeras columbiae
Koeller, 1974
Koeller and Littlepage, 1976

Bradyidius saanichi
Bradford, 1976a
Park, 1966
Shih et al., 1981

Bradyidius similis
Bradford, 1976a
Park, 1966a
Sars, 1903
Shih et al., 1981

Calanus
Gibbons, 1937
Grainger, 1964
LeBour, 1916
Sars, 1903
Woodhead and Riley, 1957, 1959
Yamada, 1971

Calanus marshallae
Brodsky, 1959, 1962
Frost, 1971, 1974

Calanus pacificus
Bradford and Jillett, 1974
Brodsky, 1948, 1959, 1962, 1967a
Park, 1968
Woodhouse, 1971

Calocalanus styliremus
Bernard, 1958
Vervoort, 1963

Candacia
Sars, 1903

Candacia bipinnata
Brodsky, 1962
Chiba et al., 1955
Davis, 1949b
Esterly, 1905
Grice, 1961
Mori, 1937
Park, 1968
Rose, 1933
Vervoort, 1965

Candacia columbiae
Campbell, 1929a
Davis, 1949b

Centraugaptilus
Sars, 1920

Centraugaptilus porcellus
Johnson, 1936

Centropages
Crisafi, 1974
Sars, 1903

Centropages abdominalis
Brodsky, 1948
Campbell, 1929a
Davis, 1949b
Kogo, 1960
Mori, 1937
Rose, 1933
Willey, 1920

Chiridius
Sars, 1903

Chiridius gracilis
Maclellan and Shih, 1974
Park, 1975b, 1978
Rose, 1933
Tanaka, 1937

Chiridius polaris
Park, 1978

Chirundina streetsi
Bradford and Jillett, 1980
Giesbrecht, 1895
Grice, 1961
Park, 1978
Rose, 1933
Vervoort, 1963

Clausocalanus arcuicornis
Brodsky, 1948, 1962
Davis, 1949b
Esterly, 1905, 1924
Frost and Fleminger, 1968
Grice, 1961
Mori, 1937
Park, 1968
Rose, 1933
Tanaka, 1937
Vervoort, 1963

Clausocalanus lividus
Frost and Fleminger, 1968

Clausocalanus parapergens
Frost and Fleminger, 1968
Mori, 1937

Ctenocalanus vanus
Davis, 1949b
Esterly, 1924
Park, 1968
Rose, 1933
Tanaka, 1937

Epilabidocera
Gibson and Grice, 1977

Epilabidocera longipedata
Brodsky, 1948
Davis, 1949b
Esterly, 1924
Johnson, 1934a
McMurrich, 1916
Park, 1965, 1966

Eucalanus
Gibbons, 1936

Eucalanus bungii
Brodsky, 1948, 1962
Davis, 1949b
Fleminger, 1973
Johnson, 1937, 1938, 1939
Lang, 1965
Mori, 1937
Park, 1968

Eucalanus californicus
Brodsky, 1948
Fleminger, 1973
Johnson, 1937, 1938, 1939
Lang, 1965

Eucalanus hyalinus
Fleminger, 1973
Lang, 1965

Euchaeta
Fontaine, 1967
Sars, 1903

Euchaeta californica
Davis, 1949b
Esterly, 1906
Park, 1977

Euchaeta elongata
Brodsky, 1948
Campbell, 1929a, 1934a
Davis, 1949b
Evans, 1973
Marukawa, 1921
Mori, 1937

Euchaeta media
Grice, 1961
Mori, 1937
Park, 1968, 1978
Rose, 1933
Vervoort, 1963

Euchaeta spinosa
Esterly, 1905
Grice, 1961
Park, 1968, 1978
Rose, 1933
Vervoort, 1963

Euchirella curticauda
Bradford and Jillett, 1980
Davis, 1949b
Grice, 1961
Park, 1976b
Rose, 1933
Vervoort, 1963

Euchirella pulchra
Davis, 1949b
Esterly, 1905
Grice, 1961
Omori, 1965
Park, 1976a, 1976b
Vervoort, 1963

Euchirella pseudopulchra
Park, 1976a

Euchirella rostrata
Bradford and Jillett, 1980
Davis, 1949b
Esterly, 1905
Park, 1968, 1976b, 1978
Rose, 1933
Sars, 1905
Vervoort, 1963

Eurytemora affinis
Campbell, 1929a
Davis, 1943
Esterly, 1924
Faber, 1966
Katona, 1971
Rose, 1933
Sars, 1903

Eurytemora americana
Faber, 1966
Heron, 1964
Katona, 1971
Williams, 1906

Eurytemora pacifica
Brodsky, 1948
Chiba, 1952
Heron, 1924
Johnson, 1961
Willey, 1920

Gaetanus intermedius
Campbell, 1930
Davis, 1949b
Park, 1973, 1975a

Gaetanus miles
Bradford and Jillett, 1980
Grice, 1961
Park, 1975a
Rose, 1933
Vervoort, 1963

Gaetanus pileatus
Bradford and Jillett, 1980
Park, 1975a, 1978
Rose, 1933
Vervoort, 1963

Gaidius
Sars, 1903

Gaidius minutus
Bradford and Jillett, 1980
Park, 1967b, 1975a
Sars, 1907

Gaidius pungens
Bradford and Jillett, 1980
Campbell, 1929a
Davis, 1949b
Esterly, 1905
Giesbrecht, 1895
Morris, 1970
Park, 1975a

Gaidius variabilis
Brodsky, 1950
Park, 1975a

Gaussia princeps
Davis, 1949b

Haloptilus
Sars, 1903

Haloptilus oxycephalus
Brodsky, 1962
Mori, 1937
Rose, 1933

Heterorhabdus
Sars, 1903, 1920

Heterorhabdus clausi
Esterly, 1905
Rose, 1949

Heterorhabdus papilliger
Esterly, 1905
Grice, 1961
Mori, 1937
Tanaka, 1937
Vervoort, 1965

Heterorhabdus robustoides
Brodsky, 1950

Heterorhabdus robustus
Rose, 1933
Vervoort, 1965

Heterorhabdus spinifrons
Esterly, 1905
Grice, 1961
Rose, 1949
Vervoort, 1965

Heterorhabdus tanneri
Bradford, 1971b
Giesbrecht, 1895
Koeller, 1974

Heterostylites
Sars, 1903

Heterostylites longicornis
Davis, 1949b
Esterly, 1905
Park, 1968
Rose, 1933
Vervoort, 1965

Heterostylites major
Rose, 1933
Vervoort, 1965

Lophothrix
Bradford, 1973

Lophothrix frontalis
Davis, 1949b
Giesbrecht, 1895
Rose, 1933
Tanaka, 1969
Vervoort, 1965

Lucicutia bicornuta
Hulsemann, 1966
Vervoort, 1965

Lucicutia flavicornis
Brodsky, 1962
Esterly, 1905, 1924
Grice, 1961
Hulseman, 1966
Mori, 1937
Park, 1968
Vervoort, 1965

Lucicutia ovalis
Grice, 1961, 1963a
Mori, 1937
Rose, 1933
Vervoort, 1965

Mecynocera clausi
Brodsky, 1962
Esterly, 1905
Mori, 1937
Rose, 1933
Vervoort, 1963

Mesocalanus tenuicornis
Bowman, 1955
Bradford and Jillett, 1974
Brodsky, 1948, 1962
Davis, 1949b
Esterly, 1905
Fulton, 1972
Grice, 1961
Mori, 1937
Mullin, 1969
Park, 1968
Rose, 1933

Metridia curticauda
Tanaka, 1963

Metridia lucens
Brodsky, 1948
Campbell, 1929a
Davis, 1949b
Esterly, 1905
Gibbons, 1933
Mori, 1937
Rose, 1933
Sars, 1903
Thorp, 1980

Metridia okhotensis
Brodsky, 1950

Metridia pacifica
Brodsky, 1948, 1950
Park, 1968
Thorp, 1980

Metridia princeps
Rose, 1933
Vervoort, 1965

Microcalanus
Sars, 1903

Microcalanus pusillus
Brodsky, 1948
Campbell, 1929a
Grainger, 1964
Rose, 1933
Sars, 1903

Neocalanus cristatus
Bradford and Jillett, 1974
Brodsky, 1948, 1962
Campbell, 1929a
Davis, 1949b
Mori, 1937
Park, 1968

Neocalanus plumchrus
Bradford and Jillett, 1974
Brodsky, 1948, 1962
Campbell, 1929a, 1930, 1934a
Davis, 1949b
Jillett, 1968
Marukawa, 1921
Mori, 1937
Park, 1968
Tanaka, 1954, 1956

Onchocalanus
Sars, 1905

Onchocalanus magnus
Brodsky, 1950
Esterly, 1906
Vervoort, 1950

Pachyptilus pacificus
Johnson, 1936

Paracalanus
Crisafi, 1974

Paracalanus parvus
Brodsky, 1948
Campbell, 1929a
Davis, 1949b
Esterly, 1905, 1924
Grice, 1961
Mori, 1937
Park, 1968
Rose, 1933
Sars, 1903

Phyllopus integer
Brodsky, 1950
Esterly, 1911

Pleuromamma abdominalis
Dahl, 1893
Davis, 1949b
Esterly, 1905
Grice, 1961
Mori, 1937
Rose, 1933
Vervoort, 1965

Pleuromamma borealis
Dahl, 1893

Pleuromamma quadrungulata
Dahl, 1893
Davis, 1949b
Grice, 1961
Vervoort, 1965

Pleuromamma robusta
Dahl, 1893
Mori, 1937
Rose, 1933
Sars, 1903
Vervoort, 1965

Pleuromamma scutullata
Brodsky, 1950

Pleuromamma xiphias
Chiba et al., 1955
Dahl, 1893
Davis, 1949b
Esterly, 1905
Grice, 1961
Mori, 1937
Rose, 1933
Vervoort, 1965

Pseudocalanus
Corkett, 1968
Sars, 1903

Pseudocalanus cf. **minutus**
Brodsky, 1948
Cattley, 1948
Corkett and McLaren, 1978
Davis, 1949b
Faber, 1966
Mori, 1937
Park, 1968
Wood, 1969

Pseudochirella
Sars, 1920

Pseudochirella polyspina
Brodsky, 1950
Park, 1978
Von Vaupel-Klein, 1970

Racovitzanus antarcticus
Brodsky, 1950

Rhincalanus nasutus
Esterly, 1905
Gibbons, 1936
Grice, 1961
Mori, 1937
Rose, 1933
Sars, 1903
Vervoort, 1963

Scaphocalanus
Bradford, 1973

Scaphocalanus affinis
Sars, 1905

Scaphocalanus brevicornis
Koeller, 1974
Rose, 1933

Scaphocalanus echinatus
Grice, 1961
Rose, 1933

Scaphocalanus magnus
Davis, 1949b
Rose, 1933
Vervoort, 1965

Scaphocalanus major
Sars, 1907

Scaphocalanus subbrevicornis
Brodsky, 1950
Tanaka, 1961

Scolecithricella
Bradford, 1973
Sars, 1903

Scolecithricella emarginata
Park, 1980
Tanaka, 1962

Scolecithricella minor
Brodsky, 1948
Mori, 1937
Park, 1968, 1980
Rose, 1933
Sars, 1903
Vervoort, 1965

Scolecithricella ovata
Park, 1980
Rose, 1933

Scolecithricella subdentata
Davis, 1949b
Esterly, 1905

Scottocalanus persecans
Davis, 1949b
Esterly, 1905
Giesbrecht, 1895
Tanaka, 1937
Vervoort, 1965

Spinocalanus brevicaudatus
Damkaer, 1975
Koeller, 1974
Semenova, 1962

Spinocalanus horridus
Damkaer, 1975

Spinocalanus longicornis
Damkaer, 1975
Sars, 1900, 1903

Tharybis
Fleminger, 1956
Sars, 1903

Tharybis fultoni
Park, 1967b

Tortanus discaudatus
Brodsky, 1948
Campbell, 1929a
Davis, 1949b
Faber, 1966
Johnson, 1934b
Mori, 1937

Undeuchaeta bispinosa
Brodsky, 1950

CYCLOPOIDA AND CALANOIDA, JUVENILE STAGES

Naupliar Stages
Evans, 1973
Fulton, 1968, 1972
Gibbons, 1933
Gibbons and Ogilvie, 1933
Johnson, 1934a, 1934b, 1937
Katona, 1971
Kogo, 1960
LeBour, 1916
Lovegrove, 1956*
Ogilvie, 1953*

Copepodite Stages
Corkett and McLaren, 1978
Evans, 1973
Fulton, 1968, 1972
Grainger, 1964
Johnson, 1934, 1934b, 1937
Katona, 1971
LeBour, 1916
Maclellan and Shih, 1974
Shih et al., 1981
Woodhead and Riley, 1957, 1959

MONSTRILLOIDA

Monstrilla
Davis, 1949a
Issac, 1974

Monstrilla canadensis
McMurrich, 1917

Monstrilla helgolandica
Park, 1967a
Rose, 1933

Monstrilla longiremis
Davis, 1949a

Monstrilla spinosa
Park, 1967a

Monstrilla wandelii
Park, 1967a

HARPACTICOIDA

Microsetella rosea
Brodsky, 1948
Campbell, 1929a
Davis, 1949b
Johnson, 1942
Mori, 1937
Rose, 1933

*Fiches d'Identification

CYCLOPOIDA

Ascomyzon rubrum
Campbell, 1929a

Corycaeus
Dana, 1845

Corycaeus catus
Campbell, 1929
Davis, 1949b
McMurrich, 1916

Corycaeus anglicus
Brady, 1878
Lubbock, 1857
Mori, 1937
Sars, 1918

Lubbockia minuta
Wolfenden, 1905

Lubbockia wilsonae
Heron and Damkaer, 1969

Macrocheiron sargassi
Campbell, 1930
Humes and Stock, 1973
Sars, 1916, 1918

Oithona
Murphy, 1923

Oithona spinirostris
Campbell, 1929
Farran, 1908
Frolander, 1962
Gibbons and Ogilvie, 1933
Sars, 1916, 1918

Oncaea borealis
Brodsky, 1948
Campbell, 1929
Rose, 1933
Sars, 1918

Oncaea conifera
Brodsky, 1948
Davis, 1949b
Esterly, 1905
Mori, 1937
Rose, 1933

Oncaea englishi
Heron, 1977

Oncaea ivlevi
Shmeleva, 1966

Oncaea prolata
Heron, 1977

Pseudolubbockia dilatata
Heron and Damkaer, 1969

Oithona similis
Brodsky, 1948
Campbell, 1929
Davis, 1949b
Gibbons and Ogilvie, 1933
Mori, 1937
Rose, 1933
Sars, 1916, 1918

11.0 ANCILLARY REFERENCES

ADACHI, R. 1972. Surface nanno-plankton collected from the northwestern north Pacific Ocean in summer 1967. Pages 139-144 In A.Y. Takenouti, ed. Biological oceanography of the northern North Pacific Ocean. Idemistu Shoten, Tokyo, Japan.

AIKAWA, H. 1932. On the summer plankton in the waters of the western Aleutian Islands in 1928. Bull. Jap. Soc. Sci. Fish I (2): 70-74.

AIKAWA, H. 1940. On the plankton associations in the Bering Sea and the Okhotsk Sea. Kaiyo-Gyogyo 5(1): 20-31 (in Japanese).

ANRAKU, M. 1954. Gymnoplea copepods collected in Aleutian waters in 1953. Bull. Fac. Fish. Hokkaido Univ. 5: 123-136.

ANRAKU, M. 1972. Planktonic copepods collected by R.S. Yushiuo Maru, in Pacific waters to the east of northern Japan during her cruise in November 1948. Bull. Fac. Fish. Hokkaido Univ. 3: 31-39 (in Japanese).

ARON, W. 1962. The distribution of animals in the eastern north Pacific and its relationship to physical and chemical condition. J. Fish. Res. Bd. Can. 19: 271-314.

BAKUN, A. 1973. Coastal upwelling indices, west coast of North America, 1946-1971. U.S. Dept. Comm., NOAA Tech. Rep. Natl. Mar. Fish. Serv. SSRF-671. 103 pp.

BIGELOW, H.B. 1922. Exploration of the coastal waters of the northwestern United States in 1916 by the U.S. Fisheries Schooner Grampus. Bull. Mus. Comp. Zool. Harv. 65: 87-188.

BIGELOW, H.B. 1926. Plankton of the offshore waters of the Gulf of Maine. Bull. U.S. Bur. Fish. 40(2): 1-509.

BOGOROV, B.G. 1958. Biogeographical regions of the plankton of the northwestern Pacific Ocean and their influence on the deep sea. Deep Sea Res. 5: 149-161.

BOWMAN, T.E. 1971a. The case of the nonubiquitous telson and the fraudulent furca. Crustaceana 21 (2): 165-175.

BOWMAN, T.E. 1971b. The distribution of calanoid copepods off the Southeastern United States between Cape Hatteras and southern Florida. Smith. Contr. Zool. 96. 58 pp.

BRADFORD, J.M. 1974. Euchaeta marina (Prestandrea) (Copepoda, Calanoida) and two closely related new species from the Pacific. Pac. Sci. 28 (2): 159-169.

BRADY, G.S. 1883. Report on the Copepoda collected by H.M.S. Challenger during the years 1873-76. Report of the scientific results of the exploring voyage of H.M.S. Challenger 1873-76. Zoology 8: 1-142, 55 pls.

BRADY, G.S. 1899. On the marine copepods of New Zealand. Trans. Zool. Soc. Lond. 15 (2): 31-54, pls. IX-XIII.

BRADY, G.S. 1900. On Ilyopsyllus coriaceus and other Crustacea taken at Alnmouth, Northumberland, in 1899. Trans. Nat. Hist. Soc. Northumb. 13: 429-442, pls. XI-XIII.

BRADY, G.S. 1918. Copepoda. Austral. Antarctic Exp. 1911-14, Sci. Rep. Ser. C-Zool. Bot. 5(3): 1-48, pls. 1-15.

BRODSKY, K.A. 1938a. Ecology and morphology of the copepod crustacean Calanus tonsus from the far eastern seas. Dokl. Acad. Nauk SSSR 21(1, 2) (in Russian).

BRODSKY, K.A. 1938b. Biology and taxonomy of the copepod crustacean Calanus cristatus Kr. Dalnev. Acad. Nauk SSSR 29(2) (in Russian).

BRODSKY, K.A. 1952a. Deepwater copepods (Calanoida) in the northwestern part of the Pacific Ocean. Issled. Dalnev. Morei SSSR 3: 37-87 (in Russian).

BRODSKY, K.A., 1952b. On the vertical distribution of copepods in the northwestern part of the Pacific Ocean. Issled. Dalnev. Morei SSSR 3: 88-94 (in Russian).

BRODSKY, K.A. 1955. The copepod fauna (Calanoida) of the Kurile-Kamchatka trench. Dokl. Akad. Nauk SSSR 12: 184-209 (in Russian).

BRODSKY, K.A. 1955a. New deep-sea copepod species in the northern Pacific Ocean. Zool. Inst. Akad. Nauk SSSR 21: 186-189 (in Russian).

BRODSKY, K.A. 1955b. Plankton distribution in the northwest Pacific. Dokl. Akad. Nauk SSSR 101(5): 961-964 (in Russian).

BRODSKY, K.A. 1956. Zonal distribution (by latitude) of copepods in the northern Pacific Ocean and adjacent waters. Dokl. Akad. Nauk SSSR 106(6): 1103-1106 (in Russian).

BRODSKY, K.A. 1957. Fauna of Calanoida (Crustacea) and the zoogeographical division into districts in the northern part of the Pacific Ocean and contiguous waters. Zool. Inst. Akad. Nauk SSSR. 222 pp. (in Russian).

BRODSKY, K.A. 1964. Distribution and some morphological features of the Antarctic species of the genus *Calanus* (Copepoda). Res. Biol. Sov. Antarct. Exp. 1955-1958. Issled. Fauny Morei 2: 189-251 (in Russian).

BRODSKY, K.A. 1965a. Variability and systematics of the species of the genus *Calanus* (Copepoda). I. *Calanus pacificus* Brodsky, 1948 and *C. sinicus* Brodsky. Issled. Fauny Morei 3(11): 22-71 (in Russian).

BRODSKY, K.A. 1965b. Systematics of marine planktonic organisms and oceanology. Okeanologiya 5(4): 577-590 (in Russian).

BRODSKY, K.A. 1967b. Distribution and length variations of individual copepod species of the family Calanidae (Copepoda) in the southern hemisphere. Issled. Fauny Morei 4(12): 190-219 (in Russian).

BRODSKY, K.A. 1972. Phylogeny of the family Calanidae (Copepoda) on the basis of comparative - morphological analysis of its characters. Issled. Fauny Morei 12(10): 5-110 (in Russian).

CAIRNS, A.A. 1967. The zooplankton of Tanquary, Ellesmere Island, with special reference to calanoid copepods. J. Fish. Res. Bd. Can. 24(3): 555-568.

CAMERON, F.E. 1957. Some factors influencing the distribution of pelagic copepods in the Queen Charlotte Islands area. J. Fish. Res. Bd. Can. 14(2): 165-202.

CAMPBELL, M.H. 1929a. A preliminary quantitative study of the zooplankton in the Strait of Georgia. Trans. Roy. Soc. Can. Ser. 3. 23(5): 1-28.

CAMPBELL, M.H. 1934b. *Calanus tonsus* Brady as an economic factor in the Strait of Georgia. Proc. 5th Pac. Sci. Congr., Can. 1933, 3: 2003-2008.

CARTER, J.C. 1965. The ecology of the calanoid copepod *Pseudocalanus minutus* Kroyer in Tessiasuk, a coastal meromictic lake of northern Labrador. Limnol. Oceanogr. 10: 345-353.

CHESTER, A.J. 1978. Microzooplankton in the surface waters of the Strait of Juan de Fuca. U.S. Dept. Comm., NOAA Tech. Rep. ERL-403-PMEL. 30 pp.

CHESTER, A.J., D.M. DAMKAER, D.B. DEY, and J.D. LARRANCE. 1977. Seasonal distributions of plankton in the Strait of Juan de Fuca. U.S. Dept. Comm., NOAA Tech. Mem. ERL MESA-24. 71 pp.

CHESTER, A.J., D.M. DAMKAER, D.B. DEY, G.A. HERON, and J.D. LARRANCE. 1980. Plankton of the Strait of Juan de Fuca, 1976-1977. U.S. EPA/ERD Rep. EPA-600/7-80-032. 64 pp. + 289 pp. on fiche.

CHISLENKO, L.L. 1967. Harpacticoids (Copepoda, Harpacticoida) of the Karelian seacoast of the White Sea. Issled. Fauny Morei 7: 48-196.

CHUCHUKALO, V.I. 1973. Species composition and distribution of macroplankton on the shelf and continental slope in the Vancouver-Oregon region in the spring of 1970. Proc. Pac. Res. Inst., Fish. and Oceanogr. 87(8): 110-119 (Translated from Russian by Translation Bureau, Dept. Secretary of State, Canada; Transl. No. 3279).

CLARKE, G.L., and D.D. BONNART. 1939. The influence of temperature on the survival, growth and respiration of Calanus finmarchicus. Biol. Bull. Woods Hole 76: 371-383.

CLAUS, C.F.W. 1863. Die freilebenden Copepoden mit besonderer Berucksichtigung der Fauna Deutschlands, der Nordsee und des Mittelmeeres, Leipzig. 230 pp., 37 pls.

CLAUS, C.F.W. 1866. Die Copepoden-Fauna von Nizza. Ein Beitrag zur Charackteristik der Formen und deren abanderungen "im sinne Darwin's." Marburg und Leipzig. 34 pp., 4 pls.

CLEVE, P.T. 1900. Notes on some Atlantic plankton organisms. K. Svenska VetnskAkad. Handl. 34(1): 1-22, 8 pls.

CONOVER, R.J. 1965. Notes on the molting cycle, development of sexual characters and sex ratio in Calanus hyperboreus. Crustaceana 8: 153-158.

CONWAY, D.V.P., and R.C. MINTON. 1975. Identification of the copepod stages of some common calanoid coepods. Dept. Agr. Fish. Scotl. Mar. Lab. New Ser. No. 7. 13 pp.

COULL, B.C. 1977. Marine flora and fauna of the northeastern United States. Copepoda: Harpacticoida. U.S. Dept. Comm., NOAA Tech. Rep., Natl. Mar. Fish. Serv. Circular 399: 1-48.

CROSS, F.A. 1964. Seasonal and geographical distribution of pelagic copepods in Oregon coastal waters. M.S. Thesis. Oregon State Univ., Corvallis. 73 pp.

CROSS, F.A., and L.F. SMALL. 1967. Copepod indicators of surface water movements off the Oregon coast. Limnol. Oceanogr. 12: 60-72.

DANA, J.D. 1845. Genus Corycaeus (Dana). Proc. Acad. Nat. Sci. Philad. 2: 285-286.

DANA, J.D. 1849. Conspectus Crustaceorum quae in orbis terrarum circumnavigatione, Carolo Wilkes e classe Reipublicae Federatae duce, lexit et descripsit Jacobus D. Dana Part II. Proc. Amer. Acad. Arts Sci. 2: 9-61 (Reprinted in Amer. J. Sci. Arts 8: 278-285).

DANA, J.D. 1853. Crustacea. Part 2. United States exploring expedition under the command of Charles Wilkes. U.S.N. Vol. 14. C. Sherman, Printer, Philadelphia. 932 pp.

DANA, J.D. 1855. Crustacea. United States Exploring Expedition under the command of Charles Wilkes. U.S.N. Atlas. C. Sherman, Printer, Philadelphia. 27 pp., 96 pls.

DAVIS, C.C., and J.M. GREEN. 1974. Three monstrilloids (Copepoda: Monstrilloida) from the Arctic. Int. Rev. Ges. Hydrobiol. 59(1): 57-63.

DAY, D.S. 1971. Macrozooplankton and nekton in the coastal waters off Vancouver Island (Canada) and Washington, spring and fall of 1963. U.S. Dept. Commer., NOAA Spec. Sci. Rep. Fish. No. 619. 94 pp.

DEEVEY, G.B. 1966. Seasonal variations in length of copepods in South Pacific waters. Aust. J. Mar. Freshwat. Res. 17(2): 155-168.

DIGBY, P.S.B. 1954. Biology of the marine planktonic copepods of Scorsby Sound, East Greenland. J. Anim. Ecol. 23: 298-338.

DUNBAR, M.J., and E.H. GRAINGER. 1952. Station list of the Calanus Expeditions 1947-48. J. Fish. Res. Bd. Can. 9(2): 65-82.

DUNBAR, M.J., and G. HARDING. 1968. Arctic Ocean water masses and plankton: a reappraisal. Pages 315-326 In J.E. Sater, coordinator. Arctic Drifting Stations. Arct. Inst. N. Amer., Washington, D.C.

ENGLISH, T.S. 1963. Some remarks on Arctic Ocean plankton. Pages 184-196 In Proceedings of the Arctic Basin Symposium, October 1962. Arct. Inst. N. Amer., Washington, D.C.

FARRAN, G.P. 1904. Records of the Copepoda taken on the Mackenzie fishing grounds off Cleggan, in 1901. Report on the Sea and Inland Fisheries of Ireland, Appendix 7(2): 18 pp., pls. 16, 17.

FARRAN, G.P. 1926. Biscayan plankton collected during a cruise on H.M.S. Research, 1900. Part XIV. The Copepoda. J. Linn. Soc. (Zool) 36: 219-310.

FARRAN, G.P. 1927. The reproduction of *Calanus finmarchicus* off the south coast of Ireland. J. Cons. Cons. Int. Explor. Mer 2: 132-143.

FARRAN, G.P. 1929. Copepoda. British Antarctic Terra Nova Expedition, 1910. Natural History Reports, Zoology 8: 203-306, 4 pls.

FARRAN, G.P. 1936. Copepoda. Great Barrier Reef Exped. 1928-1929. Sci. Rep. 5: 73-142.

FERRARI, F.D., and T.E. BOWMAN. 1980. Pelagic copepods of the family Oithonidae (Cyclopoida) from the east coasts of Central and South America. Smith. Contr. Zool. 312. 27 pp.

FISH, C.J. 1936a. The biology of *Calanus finmarchicus* in the Gulf of Maine and the Bay of Fundy. Biol. Bull. Woods Hole 70(1): 118-141.

FISH, C.J. 1936b. The biology of *Pseudocalanus minutus* in the Gulf of Maine and the Bay of Fundy. Biol. Bull. Woods Hole 70(2): 193-216.

FISH, C.J. 1936c. THe biology of *Oithona similis* in the Gulf of Maine and the Bay of Fundy. Biol. Bull. Woods Hole 71(1): 168-187.

FLEMING, R.H. 1955. Review of the oceanography of the northern Pacific. Int. North Pacific Comm. Bull. No. 2: 1-43.

FLEMINGER, A. 1964. Distributional atlas of calanoid copepods in the California current region, Part I. Calif. Coop. Oceanic Fish. Invest. Atlas 2: 1-313, pls. ix-xvi.

FLEMINGER, A. 1967a. Distributional atlas of calanoid copepods in the California current region, Part II. Calif. Coop. Oceanic Fish. Invest. Atlas 7: 1-213.

FLEMINGER, A. 1967b. Taxonomy, distribution and polymorphism in the *Labidocera jollae* group with remarks on evolution within the group (Copepoda:Calanoida). Proc. U.S. Natl. Mus. 120: 1-61.

FONTAINE, M. 1955. The planktonic copepods (Calanoida, Cyclopoida, Monstrilloida) of Ungava Bay, with special reference to the biology of *Pseudocalanus minutus* and *Calanus finmarchicus*. J. Fish. Res. Bd. Can. 12(6): 858-898.

FROLANDER, H.F., C.B. MILLER, M.J. FLYNN, S.C. MYERS, and S.T. ZIMMERMAN. 1973. Seasonal cycles of abundance of zooplankton populations in Yaquina Bay, Oregon. Mar. Biol. (Berl.) 21: 277-278.

FULTON, J.D. 1973. Some aspects of the life history of *Calanus plumchrus* in the Strait of Georgia. J. Fish. Res. Bd. Can. 30(6): 811-815.

FURUHASHI, K. 1953. On the vertical distribution of animal plankton in the Sea of Japan off Sar'in-District in summer of 1952. Publ. Seto Mar. Biol. Lab. 3(1): 61-74.

FURUHASHI, K. 1961a. On the distributions of some animals in the Kuroshio region south of Honshu, Japan, with notes on the nature and origin of the cold water mass appearing in the region. I. The distributions of copepods and chaetognaths. Umi Sora, 37(2): 45-49 (in Japanese).

FURUHASHI, K. 1961b. On the distribution of some planktonic animals in the Kuroshio region south of Honshu, Japan, with notes on the nature and origin of the cold water mass appearing in the region. II. The distribution of copepods and chaetognaths. Umi Sora, 37(4): 100-111 (in Japanese).

FURUHASHI, K. 1961c. On the possible segregation found in the Copepoda fauna in the deep waters off the south-eastern coast of Japan. Publ. Seto Mar. Biol. Lab. 9: 1-15.

FURUHASHI, K. 1965. Additional list of species of pelagic copepods from the adjacent seas of Japan. Inform. Bull. Plankton Jap. 12: 22-23.

FURUHASHI, K. 1966. Studies on the verticle distribution of copepods in the Oyashio region east of Japan and in the Kuroshio region south of Japan. Publ. Seto Mar. Biol. Lab. 14: 295-322.

FURUHASHI, K., and Y. MATSUDAIRA. 1960. On the vertical distribution of pelagic Copepoda collected from the Kuroshio region south of Honshu. Mem. Kobie Mar. Observ. 14: 81-88.

GARDNER, G.A. 1976. The analysis of zooplankton population fluctuations in Calanus plumchrus Marukawa and Calanus marshallae Frost. Ph.D. Thesis. Univ. British Columbia, Vancouver. 145 pp.

GARDNER, G.A. 1977. Analysis of zooplankton population fluctuations in the Strait of Georgia, British Columbia. J. Fish. Res. Bd. Can. 34: 1196-1206.

GARDNER, G.A. 1982a. Biological and hydrographic evidence for Pacific equatorial water on the continental shelf north of Vancouver Island, British Columbia. Can. J. Fish. Aquat. Sci. 39(5): 660-667.

GARDNER, G.A. 1982b. Patterns in the distribution and abundance of selected zooplankton species from the coast of British Columbia. Biol. Oceanogr. 1(3): 255-270.

GELETIN, Y.V. 1976. Distribution of the copepod *Metridia pacifica* in the northwestern Pacific Ocean in relation to water temperature. Sov. J. Ecol. 6(3): 243-246 (in Russian).

GELETIN, Y.V. 1977. The taxonomy, summer distribution and relation to water temperature of copepods of the genus *Pseudocalanus* (Calanoida, Pseudocalanidae) in the northwestern Pacific. Issled. Fauny Morei 21(28): 82-95 (Translated from Russian by Translation Bureau, Dept. Secretary of State, Canada; Fish. Mar. Serv. Transl Ser. 4318).

GIBBONS, S.G. 1933. A study of the biology of *Calanus finmarchicus* in the northwestern North Sea. Fish. Scotl. Sci. Invest. 1933. 1: 1-24, pls. 1-3.

GIESBRECHT, W. 1881. Vorlaufige Mitteilung aus einer Arbeit uber die Frielebenden Copepoden des Kieler Hafens. Zool. Anz. 4: 254-258.

GIESBRECHT, W. 1888. Elenco dei Copepodi pelagici raccolti dal tenente di vascello Gaetano Chierchia durante il viaggio della R. Corvetta Vettor Pisani negli anni 1882-1885, e dal tenente di vascello Francesco Orsini nel Mar Rosso, nel 1884. Nota II. Atti. R. Accad. Lincei, Rome, Ser. 4. Vol. 4. Sem. 2: 330-338.

GIESBRECHT, W. 1889. Elenco dei copepodi pelagici raccolti dal tenente di vascello Gaetano Chierchia durante il viaggio della R. Corvetta Vettor Pisani negli anni 1882-1885, e dal tenente di vascello Francesco Orsini nel Mar Rosso, nel 1889. Atti R. Acad. Lincei, Rome, Ser. 4. Vol. 5. Sem. 2: 24-29.

GIESBRECHT, W. 1892. Systematik und Faunistik der pelagischen Copepoden des Golfes von Neapel und der angrenzenden Meeresabschnitte. Faun. Flor. des Golfes von Neapel, Monogr. 19. 831 pp., 54 pls.

GIESBRECHT, W. 1897. Notizen zur Systematik der Copepoden. Zool. Anz. 20: 253-255.

GIESBRECHT, W., and O. SCHMEIL. 1898. Copepoda. I. Gymnoplea. Das Tierreich 6. XVI + 169 pp.

GIESBRECHT, W. 1902. Copepoden. Resultats du voyage du S.Y. Belgica. Expedition Antarctique Belge. Rapp. Sci., Zool. 49 pp., 13 pls.

GIESBRECHT, W. 1903. Copepodi *In* S. Lo Bianco, ed. Le pesche abissali esequite da F.A. Krupp col yacht Puritan nelle adiacenze di Capri ed in altre localita del Mediterraneo. Mittheil. aus der Zool. Stat. zu Neapel 16(1,2): 109-279, pls. 7-9.

GRAINGER, E.H. 1961. The copepods Calanus glacialis Jaschnov and Calanus finmarchicus (Gunnerus) in Canadian arctic-subarctic waters. J. Fish. Res. Bd. Can. 18: 663-678.

GRAINGER, E.H. 1962. Zooplankton of Foxe Basin in the Canadian Arctic. J. Fish. Res. Bd. Can. 19: 377-400.

GRAINGER, E.H. 1963. Copepods of the genus Calanus as indicators of eastern Canadian waters. Pages 68-94 In M.J. Dunbar, ed. Marine distributions. Univ. Toronto Press, Toronto.

GRAINGER, E.H. 1965. Zooplankton from the Arctic Ocean and adjacent Canadian waters. J. Fish. Res. Bd. Can. 22: 543-564.

GRICE, G.D. 1962. Copepods collected by the nuclear submarine Seadragon on a cruise to and from the North Pole, with remarks on their geographic distribution. J. Mar. Res. 20: 97-109.

GRICE, G.D. 1963b. A revision of the genus Candacia (Copepoda: Calanoida) with an annotated list of the species and a key for their identification. Zool. Meded., Leiden 38: 171-194.

GRICE, G.D. 1971. Deep water calanoid copepods from the Mediterranean Sea. Family Spinocalanidae. Cah. Biol. Mar. 12: 273-281.

GRICE, G.D., and K. HULSEMANN. 1968. Calanoid copepods from midwater trawl collections made in the southeastern Pacific Ocean. Pac. Sci. 22(3): 322-335.

GURNEY, R. 1931. British fresh-water Copepoda. Ray Soc. Publ. 1(118): 1-238.

GURNEY, R. 1934. Development of Rhincalanus. Discovery Rep. 9(5): 207-214.

HARDING, J.P., and W.A. SMITH. 1960. A key to the British freshwater cyclopoid and calanoid copepods. Freshwat. Biol. Ass. Sci. Publ. No. 18. 54 pp.

HARTMAN, O. 1961. A new monstrillid copepod parasitic in capitellid polychaetes in southern California. Zool. Anz. 176: 325-334.

HEBARD, J.F. 1956. The seasonal variation of zooplankton in Puget Sound. M.S. Thesis, Univ. Wash., Seattle.

HEBARD, J.F. 1966. Distribution of Euphausiacea and Copepoda of Oregon in relation to oceanographic conditions. Ph.D. Thesis, Oregon State Univ., Corvallis. 85 pp.

HEINLE, D.R. 1966. Production of a calanoid copepod, Acartia tonsa, in the Patuxient River Estuary. Chesapeake Sci. 7(2): 59-74.

HEINRICH, A.K. 1957. Propagation and level of the abundance of copepods in the Bering Sea. Trudy Leningr. Obshsh. Estest. 8: 143-162 (in Russian).

HEINRICH, A.K. 1959. Biological seasons in the plankton of the Bering Sea and horizontal distribution of zooplankton biomass. Trudy Inst. Okeanol. Akad. Nauk SSSR 30: 107-114 (in Russian).

HEINRICH, A.K. 1968. Quantitative distribution of the planktonic animals in the west Pacific. Pages 29-86 In M.J. Semina, ed. Plankton of the Pacific Ocean. Izdat. "Nauka," Moscow.

HERON, G.A., and D.M. DAMKAER. 1978. Seven Lubbockia species (Copepoda: Cyclopoida) from the plankton of the northeast Pacific, with a review of the genus. Smith. Contr. Zool. 267. 36 pp.

HIDA, T.S., and J.E. KING. 1955. Vertical distribution of zooplankton in the central equatorial Pacific, July-August 1952. Fish Wildl. Serv. U.S. Spec. Sci. Rept. 144. 22 pp.

HUGHES, K.H. 1968. Seasonal vertical distribution of copepods in the Arctic water in the Canadian basin of the North Polar Sea. M.S. Thesis, Univ. Wash., Seattle. 85 pp.

HULSEMANN, K., and A. FLEMINGER. 1975. Some aspects of copepod development in the genus Pontellina Dana (Copepoda: Calanoida). Bull. Mar. Sci. 25(2): 174-185.

JASCHNOV, V.A. 1955. Morphology, distribution and systematics of Calanus finmarchicus s.l. Zool. Zhur. 34(6): 1210-1223 (in Russian).

JASCHNOV, V.A. 1957a. Derjuginia - a new genus of Copepoda of the Polar basin. Bull. Mosk. Obshch. Isp. Prirob. Biol. 52(4): 3-9 (in Russian).

JASCHNOV, V.A. 1957b. Comparative morphology of the species Calanus finmarchicus s.l. Zool. Zhur. 36: 191-198 (in Russian).

JASCHNOV, V.A. 1957c. Pacific Ocean species of Calanus finmarchicus s.l. Izv. Tikhookean. Nauchno-Issled. Inst. Rybn. Khoz. Okeanogr. 44: 253-255 (in Russian).

JASCHNOV, V.A. 1958. The origin of the species Calanus finmarchicus s.l. Zool. Zhur. 34: 838-845 (in Russian).

JASCHNOV, V.A. 1961. Water masses and plankton. I. Species of Calanus finmarchicus s.l. as indicators of definite water masses. Zool. Zhur. 40: 1314-1334 (in Russian).

JASCHNOV, V.A. 1963. Water masses and plankton. I. Calanus glacialis and Calanus pacificus as indicators of definite water masses in the Pacific. Zool. Zhur. 42: 1005-1021 (in Russian).

JOHNSON, M.W. 1932. Seasonal distribution of plankton at Friday Harbor, Washington. Univ. Wash. Publ. Oceanogr. 1(1): 1-38.

JOHNSON, M.W. 1934c. The production and distribution of zooplankton in the surface waters of Bering Sea and Bering Strait, with special references to copepods, echinoderms, mollusks, and annelids. Report of Oceanographic Cruise, U.S. Coast Guard Cutter Chelan 1934. 2: 45-82.

JOHNSON, M.W. 1953. Studies on plankton of the Bering Sea and Chukchi Sea and adjacent waters. Proc. 7th Pac. Sci. Cong. Zool.: 480-500.

JOHNSON, M.W. 1956. The plankton of the Beaufort and Chukchi Sea areas of the Arctic and its relation to the hydrography. Arctic Inst. N. Amer. Tech. Paper 1: 1-32.

JOHNSON, M.W. 1958. Observations on inshore plankton collected during summer 1957 at Point Barrow, Alaska. J. Mar. Res. 14: 272-281.

JOHNSON, M.W. 1963. Zooplankton collections from the High Polar Basin with special reference to the Copepoda. Limnol. Oceanogr. 8: 89-102.

KING, J.E., and J. DEMOND. 1953. Zooplankton abundance in the central Pacific. Fish Wildl. Serv. U.S. Spec. Sci. Rept. 201. 55 pp.

KITOU, M., and O. TANAKA. 1969. Notes on a species of Calanoides (Copepoda, Calanoida) from the North Pacific. Oceanogr. Mag. 21(1): 67-81.

KRAUSE, E.P., and A.G. LEWIS. 1979. Ontogenetic migration and the distribution of Eucalanus bungii (Copepoda: Calanoida) in British Columbia inlets. Can. J. Zool. 57(11): 2211-2222.

KROYER, H. 1848. Karcinologiske Bidrag. Naturh. Tidsskr., Copenhagen 2: 527-560, 563-609.

LANG, K. 1948. Monographie der Harpacticiden. Reprinted in 1975, Otto Koeltz Science Publ., W.Germany. 1682 pp.

LANG, B.T. 1967. The taxonomic problem of Eucalanus elongatus Dana. Ann. Fac. Sci. Univ. Saigon: 93-102.

LAURS, R.M. 1967. Coastal upwelling and the ecology of lower trophic levels. Ph.D. Thesis, Oregon State Univ., Corvallis. 121 pp.

LE BRASSEUR, R.J. 1955. Oceanography of British Columbia mainland inlets. VI. Plankton distribution. Fish. Res. Bd. Can. Pac. Prog. Rept. 103: 19-21.

LE BRASSEUR, R.J. 1965a. Biomass atlas of net zooplankton in the northeastern Pacific Ocean, 1956-1964. Fish. Res. Bd. Can. Ms. Rep. Ser. 201. 14 pp.

LE BRASSEUR, R.J. 1965b. Seasonal and annual variations of net zooplankton at Ocean Station P 1956-1964. Fish. Res. Bd. Can. Ms. Rep. Ser. 202. 163 pp.

LE BRASSEUR, R.J., and J.D. FULTON. 1967. A guide to zooplankton of the northeastern Pacific Ocean. Fish. Res. Bd. Can. Pac. Oceanogr. Group, Nanaimo, B.C. Circ. 84. 321 pp.

LEE, C.M. 1972. Structure and function of the spermatophore and its coupling device in the Centropagidae (Copepoda, Calanoida). Bull. Mar. Ecol. 8: 1-20, pls. I-X.

LEE, W. 1971. The copepods in a collection from the southern Oregon coast, 1963. M.S. Thesis, Oregon State Univ., Corvallis. 62 pp.

LEGARE, J.E.H. 1957. The qualitative and quantitative distribution of plankton in the Strait of Georgia in relation to certain oceanographic factors. J. Fish. Res. Bd. Can. 14: 521-552.

LEWIS, A.G. 1972. Hydrographic conditions and the seasonal effect of an enrichment medium on the early developmental stages of Euchaeta japonica (Crustacea, Copepoda, Calanoida). Pages 395-401 In A.Y. Takenouti et al., eds. Biological Oceanography of the northern North Pacific Ocean. Idemitsu Shoten, Tokyo, Japan.

LEWIS, A.G., and A. RAMNARINE. 1969. Some chemical factors affecting the early developmental stages of Euchaeta japonica (Crustacea: Copepoda: Calanoida) in the laboratory. J. Fish. Res. Bd. Can. 26: 1347-1362.

LEWIS, A.G., A. RAMNARINE, and M.S. EVANS. 1971. Natural chelators -an indication of activity with the calanoid copepod Euchaeta japonica. Mar. Biol. 11: 1-4.

LINKO, A. 1913. Zooplankton of the Siberian Arctic Ocean according to the collections made by the Russian Polar expeditions of 1900-1903. (Zooplancton dela mer glacale de Siverie d'apres les recoltes de l'Expedition Polaire Russe en 1900-1903.) Mem. Acad. Sci. Ser. 8, 29(4): 1-54, 2 pl.

LOCK, A.N., and I.A. MC LAREN. 1970. The effect of varying and constant temperatures on the size of a marine copepod. Limnol. Oceanogr. 15: 638-640.

LUBBOCK, J. 1854. On some Arctic species of Calanidae. Ann. Mag. Nat. Hist. Ser. 2. 14: 125-129.

LUBBOCK, J. 1856. On some Entomostraca collected by Dr. Sutherland in the Atlantic Ocean. Trans. Roy. Ent. Soc. Lond. N.S. 4: 8-37, pls. 2-12.

MC ALLISTER, C.D. 1961. Zooplankton studies at ocean weather station "P" in the northeast Pacific Ocean. J. Fish. Res. Bd. Can. 18(1): 1-29.

MC LAREN, J.A. 1965. Some relationships between temperature and egg size, body size, development rate, and fecundity of the copepod *Pseudocalanus*. Limnol. Oceanogr. 10: 528-538.

MACKAS, D.L., G.C. LOUTTIT, and M.J. AUSTIN. 1980. Spatial distribution of zooplankton and phytoplankton in British Columbian coastal waters. J. Fish. Res. Bd. Can. 37(10): 1476-1487.

MALAQUIN, A. 1901. Le parasitiste evolutif des monstrillides (Crustaces, Copepods). Arch. Zool. Exp. Gen. 9: 81-232.

MARLOWE, C.J., and C.B. MILLER. 1975. Patterns of vertical distribution and migration of zooplankton at Ocean Station "P". Limnol. Oceanogr. 20(5): 824-844.

MARSHALL, S.M., and A.P. ORR. 1955. The biology of a marine copepod, *Calanus finmarchicus* (Gunnerus). Oliver and Boyd Press, London. 188 pp.

MARSHALL, S.M. 1973. Respiration and feeding in copepods. Pages 57-120. *in* F. Russell and M. Yonge, eds. Advances in marine biology. Vol. *11*. Academic Press, London.

MARUKAWA, M. 1908. Plankton - Organisms of Japan. Copepoda collected off the Coast of Provinces Boshu, Izu, Suruga. Suisan Koshynjo Suiken Hokoku, Tokyo 4: 1-23 (in Japanese, English summary).

MATSUDAIRA, Y., and K. FURUHASHI. 1955. Notes on some animal plankton collected from deep layers of the Pacific waters off southern Japan. Umi Sora 31: 11-73 (in Japanese).

MATTHEWS, J.B.L. 1966. Experimental investigations of the systematic status of *Calanus finmarchicus* and *C. glacialis* (Crustacea, Copepoda). Pages 479-492 *In* H. Barnes, ed. Some contemporary studies in marine science. George, Allen and Unwin Ltd., London.

MEDNIKOV, B.M. 1961. On the sex ratio in deep water Calanoida. Crustaceana 3(2): 105-109.

MESHCHERYAKOVA, I.M. 1970. Plankton of the eastern Bering Sea in Spring and Autumn. Trudy Vses. Nauchno-Issled. Inst. Morsk. Rybn. Khoz. Okeanogr. 70: 92-108 (in Russian).

MINODA, T. 1971. Pelagic Copepoda in the Bering Sea and the North Western North Pacific with special reference to their vertical distribution. Mem. Fac. Fish. Hokkaido Univ. 18 (1-2): 1-108, 13 figs.

MINODA, T. 1972. Characteristics of the vertical distribution of copepods in the Bering Sea and south of the Aleutian Chain, May-June, 1962. Pages 323-332 In A.Y. Takenouti, ed. Biological oceanography of the northern North Pacific Ocean. Idemitsu Shoten, Tokyo.

MINODA, T., and R. Marumo. 1975. Regional characteristics of distribution of phyto- and zooplankton in the eastern Bering Sea and Chukchi Sea in June-July, 1972. Pages 83-95 In D.W. Hood and Y. Takenouti, eds. Bering Sea Oceanography: An Update, Resuits of US-Japan Seminar/Workshop on Bering Sea Oceanography. Rep. R75-2, Inst. Mar. Sci., Univ. Alaska, Fairbanks.

MINODA, T., T. NISHIYAMA, and M. FUKUCHIJ. 1975. Peculiarity of zooplankton biomass distribution in the Bering Sea in fall season. (in Japanese, English abstract). Ann. Meeting Oceanogr. Soc. Japan, April, Tokyo.

MORI, T. 1942. Systematic studies of the plankton organisms occurring in Iwayama Bay, Palao. IV. Copepoda from the bay and adjacent waters. Palao. Trop. Biol. Stn. Stud. 2(3): 549-580.

MOTODA, S. 1943. Seasons of occurrence of Calanus plumchrus (Copepoda) in Aomori Bay and Oshoro Bay. Prog. Rep. Hokkaido Fish. Sci. Inst. 282. 207 pp.

MOTODA, S., and S. KOKUBO. 1933. On the morphology and ecology of Calanus cristatus Kroyer. Plankton Jiho (Bull. of Planktology) No. 6.

MOTODA, S., and R. MARUMO 1963. Plankton of the Kuroshio Water. Proc. Symp. Kuroshio: 40-81.

MOTODA, S., and T. MINODA. 1970. Herbivorous zooplankton-phytoplankton relationship in the western North Pacific (142oE). 2nd CSK Symp. Abstracts, 28 Sept.-1 Oct. 1970. Japanese National Commission for UNESCO:30.

MOTODA, S., and T. MINODA. 1972. Plankton of the Bering Sea largely based on the material obtained during the cruises of the 'Oshoro Maru', 1954-1970. Proc. Symp. Bering Sea Study, Hakodate, Jan.-Feb. 1972.

MOTODA, S., and T. MINODA. 1974. Plankton of the Bering Sea. *In* D.W. Hood and Y. Takenouti, eds. Oceanography of the Bering Sea with emphasis on renewable resources. Occ. Publ. No. 2, Inst. Mar. Sci., Univ. Alaska, Fairbanks. 623 pp.

MRAZEK, A. 1902. Arktische Copepoden. Fauna Arct. 2: 499-528.

MULLIN, M.W. 1967. Lab culture of *Rhincalanus nasutus*. Limnol. Oceanog. 12(4): 657 666.

MYERS, A. 1975. Vertical distribution of zooplankton in Oregon coastal zone during an upwelling event. M.S. Thesis, Oregon State Univ., Corvallis. 60 pp.

NAKAI, Z. 1952. On quantitative distribution of plankton reproduced in the northern Pacific. Tokai Reg. Res. Lab. Spec. Publ. 2: 1-6.

OLSON, J.B. 1949. The pelagic cyclopoid copepods of the coastal waters of Oregon, California and Lower California. Ph.D. Thesis. Univ. Calif., Los Angeles. 208 pp.

OMORI, M. 1965b. The distribution of zooplankton in the Bering Sea and northern North Pacific by high speed sampling of the surface waters, with special reference to the copepods. J. Oceanogr. Soc. Jap. 21(1): 18-27.

OMORI, M., and O. TANAKA. 1967. Distribution of some cold-water species of copepods in the Pacific water off east-central Honshu, Japan. J. Oceanogr. Soc. Jap. 23(2): 63-73.

OWRE, H.B., and M. FOYO. 1964. Report on a collection of Copepoda from the Caribbean Sea. Bull. Mar. Sci. Gulf. Caribb. 14: 359-372.

PANDYAN, A.S. 1971. Food and trophic relations of the developmental stages of marine copepods *Euchaeta japonica* (Marukawa) and *Calanus plumchrus* (Marukawa). Ph.D. Thesis. Univ. British Columbia, Vancouver.

PARK, T. 1970. Calanoid copepods from the Caribbean Sea and Gulf of Mexico. 2. New species and new records from plankton samples. Bull. Mar. Sci. 20(2): 472-546.

PARK, T. 1975c. A new species of *Euchirella* and the male of *Euchirella splendens* Vervoort, with notes on *Euchirella truncata* Esterly (*Copepoda, Calanoida*). Crustaceana 28(3): 291-297.

PARSONS, T.R., R.J. LEBRASSEUR, and W.E. BARRACLOUGH. 1970. Levels of production in the pelagic environment of the Strait of Georgia, British Columbia: A review. J. Fish. Res. Bd. Can. 27: 1251-1264.

PARSONS, T.R., R.J. LEBRASSEUR, J.D. FULTON, and O.D. KENNEDY. 1969. Production studies in the Strait of Georgia. Part II. Secondary production under the Fraser River plume, February to May, 1967. J. Exp. Mar. Biol. Ecol. 3: 39-50.

PELSENEAR, P. 1914. Ethologie de quelques Odostomius et d'un monstrillide parasite de l'un d'eux. Bull. Sci. France Belgique 48: 1-14.

PETERSON, W.K., and G.C. ANDERSON. 1966. Net zooplankton data from the northeast Pacific Ocean: Columbia River effluent area, 1961, 1962. Univ. Wash. Tech. Rep. 160. 225 pp.

PETERSON, W.K., and C.B. MILLER. 1975. Year-to-year variations in the planktology of the Oregon upwelling zone. Fish. Bull. 73: 642-653.

PETERSON, W.K., and C.B. MILLER. 1976. Zooplankton along the continental shelf off Newport, Oregon, 1969-1972: Distribution, abundance, seasonal cycle, and year-to-year variations. Oregon State Univ. Sea Grant College Program Publ. ORESU-T-76-002. 111 pp.

PETERSON, W.K., and C.B. MILLER. 1977. Seasonal cycle of zooplankton abundance and species composition along the central Oregon coast. Fish. Bull. 75: 717-724.

PETERSON, W.K. 1972. Distribution of pelagic Copepoda off the coasts of Washington and Oregon during 1961 and 1962. Pages 313-342 In A.T. Pruter and D.L. Alverson, eds. The Columbia River Estuary and adjacent ocean waters. Univ. Wash. Press, Seattle.

PETERSON, W.K., C.B. MILLER, and A. HUTCHINSON. 1979. Zonation and maintenance of copepod populations in the Oregon upwelling zone. Deep Sea Res. 26: 467-494.

POPPE, S.A. 1884. Free-living Copepoda from the North Pacific Ocean and the Bering Sea. Arch. Naturg. 50: 281-304.

ROSE, M. 1942. Les Scolecithricidae (Copepodes pelagiques) de la Baie d'Alger. Ann. Inst. Oceanogr. Monaco 21: 113-170.

ROSE, M., and R. VAISSIERE. 1952. Catalogue preliminaire des copepodes de l'Afrique du Nord. Soc. Bull. Soc. Nat. Hist. N. Afrique 33(7): 113-136.

SARS, G.O. 1898. The Cladocera, Copepoda and Ostracoda of the Jana Expedition. Ezheg. Zool. Myz. Akad. Nauk. 3: 324-359 (in Russian).

SARS, G.O. 1900. Crustacea. The Norwegian North Polar Expedition 1893-1896, Sci. Res. 5. 141 pp., 36 pls.

SARS, G.O. 1921. An account of the Crustacea of Norway. Vol. 8. Copepoda, Monstrilloida and Notodelphyoida. Bergen Mus. Press, Norway. Pts. 1-6, pp. 1-91, pls. 1-37.

SARS, G.O. 1924, 1925. Copepodes particulierement bathypelagiques provenant des campagnes scientifiques du Prince Albert Ier de Monaco. Result. Campagnes Sci. 69. 46 pp., 127 pls. (1924); 408 pp. (1925)

SATO, T. 1913. Pelagic copepods. Rpt. Fish. Res. Hokkaido Fish. Exp. Sta. I. 79 pp. (in Japanese).

SCOTT, A. 1909. The Copepoda of the Siboga Expedition. I. Free swimming, littoral and semi-parasitic Copepoda. Siboga Exped., Monogr. 29. 323 pp.

SCOTT, T. 1894. Report on Entomostraca from the Gulf of Guinea. Trans. Linn. Soc. Lond. Ser. 2, Zool., Vol. 6. Part I.

SCOTT, T. 1903. Notes on some Copepoda for the Arctic Seas collected by A.M. Norman. Ann. Mag. Nat. Hist. Vol. II.

SCOTT, T. 1909. On some new and rare Entomostraca from the Scottish Seas. Ann. Mag. Nat. Hist. Ser. B. 3: 112-120, pls. 2-4.

SEWELL, R.B.S. 1929, 1932. The Copepoda of the Indian Seas, Calanoida. Mem. Indian Mus. 10: 1-407, 6 pls.

SEWELL, R.B.S. 1947. The free-swimming planktonic Copepoda. Systematic account. Sci. Rept. J. Murray Exped. Vol. 8. 303 pp.

SEWELL, R.B.S. 1948. The free swimming planktonic Copepoda. Geographical distribution. Sci. Rept. J. Murray Exped. 1933-1934 8: 21-592.

SEWELL, R.B.S. 1949. The littoral and semi-parasitic Cyclopoida, Monstrilloida and Notedelphyoida. Sci. Rept. J. Murray Exped. 1933-34. 9: 1-19.

SHAN, K-C. 1962. Systematic and ecological studies on Copepoda in Indian Arm, British Columbia. M.Sc. Thesis, Univ. British Columbia, Vancouver. 185 pp.

SHEN, C.J., and S.O. BAI. 1956. The marine Copepoda from the spawning ground of Pneumatophorus japonicus (Houttuyn) off Chefoo, China. Acta Zool.Sinica 8: 217-234, 13 pls.

SHERMAN, K. 1963. Pontellid copepod distribution in relation to surface water types in the central north Pacific. Limnol. Oceanogr. 8: 214-227.

SHERMAN, K. 1964. Pontellid copepod occurrence in the central south Pacific. Limnol. Oceanogr. 9: 476-484.

SIMENSTAD, C.A., W.J. KINNEY, and B.S. MILLER. 1980. Epibenthic zooplankton assemblages at selected sites along the Strait of Juan de Fuca. U.S. Dept. Commer., NOAA Tech. Memo. ERL MESA-46. 73 pp.

SMIRNOV, S. 1931. Zur Kenntnis der Copepoden Gattung *Eurytemora* Giesbr. Zool. Anz. 94: 194-201.

SMIRNOV, S. 1936. Beschreiburg Einer neuen *Acartia* art aus dem Japanischen Meer nebst einiger Bemerkunden uber die Untergattung *Eucartia* Steuer. Zool. Anz. 114: 87-92.

STEUER, A. 1904. Copepoden der Valdivia Expedition. Zool. Anz. 27(19): 593-598.

STEUER, A. 1915. Revision der Gattung *Acartia* Dana. Zool. Anz. 45(9): 392-397.

STEUER, A. 1923. Bausteine zu einer Monographie der Copepoden Gattung *Acartia*. Arb. Zool. Inst. Univ. Innsbruck 1(5): 89-148.

STEUER, A. 1929. Die Arten der Copepoden Gattung *Acartia* in der Mediterranean Provinz. Sitzungs Berich der Akad.Wissansch. Wien, Matematisch Naturwissensch. 138: 497-516.

STEUER, A. 1932. Copepoda 6: *Pleuromamma* Giesbr. 1898 der Deutschen Tiefsee Expedition. Wiss. Ergebn. der Deutschen Tiefsee Exped. 1898-1899. Vol. 24. Part 1. 119 pp., 17 maps, 196 figs.

STONE, D.P. 1977. Copepod distribution ecology in a glacial run-off fjord. Ph.D. Thesis. Univ. British Columbia, Vancouver. 256 pp.

STONE, D.P. 1979. The distribution of zooplankton communities in a glacial run-off fjord and exchanges with the open sea. Pages 291-304 *In* H.J. Freeland, D.M. Farmer, and C.D. Levings, eds. Fjord oceanography. Plenum Press, New York and London.

TANAKA, O. 1937. Copepods from deep water of Suruga Bay. Jap. J. Zool. 7: 251-271.

TANAKA, O. 1938. Notes on *Calanus cristatus* Kroyer. Jap. J. Zool. 7: 599-601.

TANAKA, O. 1953. The pelagic copepods of the Izu Region. Rec. Oceanogr. Wks. Jap., N.S. 1: 126-137.

TANAKA, O. 1960a. Pelagic Copepoda. Biological results of the Japanese Antarctic Research Expedition No. 10. Spec. Publ. Seto Mar. Biol. Lab. 10: 1-177.

TANAKA, O. 1960b. Pelagic Copepoda. Biological results of the Japanese Antarctic Research Expedition No. 10. Spec. Publ. Seto Mar. Biol. Lab. 10: 1-95.

TIMM, I.R. 1893. Monstrilla grandis Giesbr., M. helgolandica Claus, Thaumaleus germanicus n. sp. Zool. Anz. 16: 418-420.

THOMPSON, I.C. 1903. Report on the Copepoda obtained by Mr. George Murray, F.R.S., during the cruise of the Oceana in 1898. Ann. Mar. Nat. Hist. Ser. 7. 12: 1-36.

THRELKELD, S.T. 1977. The distribution of five species of Monstrillidae (Copepoda, Monstrillidae) near Kodiak Island, Alaska. Crustaceana 32(3): 225-228.

VAN BREEMAN, P.J. 1908. Copepoden. Nord. Plankt. 4(8): 1-264.

VERVOORT, W. 1946. The Copepoda of the Snellius Expedition, I.E.J. Brill., Leiden, 181 pp.

VERVOORT, W. 1951. Plankton copepods from the Atlantic section of the Antarctic. Verh. K. Akad. Wet. Ser. 2. 47(4): 1-56.

VERVOORT, W. 1957. Copepods from Antarctic and sub-Antarctic plankton samples. Rep. B.A.N.Z. Antarct. Res. Exped. Ser. B. Vol. 3. 160 pp., 138 figs.

VON VAUPEL-KLEIN, J.C. 1970. Notes on a small collection of the N.E. Pacific including the description of a new species of Undinella (Family Tharybidae). Zool. Verh., Leiden 110: 43.

WAILES, G.H. 1929. The marine zooplankton of British Columbia. Vancouver, B.C. Mus. Art. Notes 4: 159-165.

WELLS, J.B.J. 1976. Keys to aid in the identification of marine harpacticoid copepods. Unpubl. Ms. Univ. Aberdeen, Scotland. 215 pp.

WELLS, J.B.J. 1978. Keys to aid in the identification of marine harpacticoid copepods. Amendment Bull. No. 1 Victoria Univ. Wellington, Zool. Publ. 70: 1-11.

WELLS, J.B.J. 1979. Keys to aid in the identification of marine harpacticoid copepods. Amendment Bull. No. 2. Victoria Univ. Wellington, Zool. Publ. 73: 1-8.

WELLS, J.B.J. 1981. Keys to aid in the identification of marine harpacticoid copepods. Amendment Bull. No. 3. Victoria Univ. Wellington, Zool. Publ. 75: 1-13.

WILLEY, A. 1919. Report on the Copepoda obtained in the Gulf of St. Lawrence and adjacent waters, 1915. Pages 173-220 In J. Hjort, ed. Can. Fish. Exped. 1914-1915. Dep. Nav. Ser., Ottawa.

WILLEY, A. 1923. Notes on the distribution of free-living Copepoda in Canadian waters. Contr. Can. Biol. N.S. 1: 305-333.

WILSON, C.B. 1932. The copepods of the Woods Hole region, Massachusetts. Bull. U.S. Natl. Mus. 158. 635 pp.

WILSON, C.B. 1942. The copepods of the plankton gathered during the last cruise of the Carnegie 1928-1929. Carnegie Inst. Wash. Publ. 536. 237 pp., 36 figs.

WITH, C. 1915. Copepoda. I. Calanoida Amphascandria. Dan. Ingolf. Exped. 3, 4: 1-260.

WOLFENDEN, R.N. 1902. The plankton of the Faroe Channel and Shetlands. Preliminary notes on some Radiolaria and Copepoda. J. Mar. Biol. Ass. U.K. 6: 344-372, pls. 1-4.

WOLFENDEN, R.N. 1904. Notes on the Copepoda of the North Atlantic Sea and Faroe Channel. J. Mar. Biol. Ass. U.K. 7: 110-146, 9 pls.

WOLFENDEN, R.N. 1905. Notes on the collection of Copepoda. Pages 989-1040 In J.S. Gardiner, ed. The fauna and geography of the Maldive and Laccadive Archipelagoes. Vol. 2 Suppl. 1.

WOLFENDEN, R.N. 1906. Plankton studies, preliminary notes upon new or interesting species. Part. II. Copepoda. Rebman Ltd., London. pp. 25-44, pls. 8-15.

WOLFENDEN. R.N. 1908. Crustacea. VIII. Copepoda, National Antarctic Expedition 1901-1904. Zoology 4(8): 1-46, pls. 1-7.

WOLFENDEN, R.N. 1911. Die Marinen Copepoden der Deutschen Subpolar Expedition 1901-1903, II. Die pelagischen Copepoden den Westwinddrift und des sudlichen Eismeers. Dutsch. Sudpolar Exped. 12: 181-401, pls. 22-44.

YAMAZI, I. 1953. Plankton investigation in inlet waters along the coast of Japan. The plankton of Kamaisi Bay on the eastern coast of the Tahuku District. Publ. Seto Mar. Biol. Lab. 3(3): 189-204.

ZUEREVA, J.A. 1976. A new species of Pseudochirella (Copepoda, Calanoida) from the Bering Sea and the female of Pseudochirella pacifica Brodsky from the North-East Pacific. Crustaceana 31(2): 200-202.